TIMBER SUPPLY BRANCH

TIMBER SUPPLY REVIEW

Kamloops Timber Supply Area Analysis Report

July 2001

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Kamloops Timber Supply Area Analysis Report

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Preface

This report contains a timber supply analysis and socio-economic analysis and is part of the provincial Timber Supply Review carried out by the British Columbia Forest Service. The purpose of the review is to examine the short- and long-term effects of current forest management practices on the availability of timber for harvesting in timber supply areas (TSAs) and tree farm licences (TFLs) throughout British Columbia.

To determine allowable timber harvesting levels accurately and rationally, the chief forester must have an up-to-date assessment of the timber supply based on the best available information and reflecting current management direction. **The report that follows provides this assessment but should not be construed as a recommendation on permissible harvest levels.**

This report focuses on a single forest management scenario — current management practices. Current management practices are defined by the specifications in management plans for the timber supply area including guidelines for the protection of forest resources, the *Forest Practices Code (FPC) of B.C. Act* and official land-use decisions made by Cabinet.

Assessing the implications of only current practices rather than looking at a number of different management schemes will expedite the analysis process, allowing analysis of all TSAs in the province every five years. An important part of these analyses is an assessment of how results might be affected by uncertainties — a process called sensitivity analysis. Together, the sensitivity analyses and the assessment of the effects of current forest management on the timber supply form a solid basis for discussions among stakeholders about alternative timber harvesting levels.

In addition to having an up-to-date assessment of timber supply when setting the allowable annual cut (AAC) the chief forester considers short- and long-term implications of alternative harvest levels, capabilities and requirements of existing and proposed processing facilities, and the social and economic objectives of the Crown. The socio-economic analysis provides the chief forester with some of the information necessary for these considerations.

Executive Summary

As part of the provincial Timber Supply Review, the British Columbia Forest Service has examined the availability of timber in the Kamloops Timber Supply Area (TSA). The analysis assesses how current forest management practices affect the supply of wood available for harvesting over both the short- (next 20 years) and long- (next 250 years) term. It also examines the potential changes in timber supply stemming from uncertainties about forest growth and management actions. **It is important to note that the various harvest forecasts included in the report indicate only the timber supply implications of current practices and uncertainty. As such, the forecasts should be used for discussion purposes only; they are not allowable annual cut (AAC) recommendations.**

The Kamloops TSA covers about 2.67 million hectares of area in the south central interior of British Columbia. Within this area, 1 409 000 hectares are productive forest, and 1 041 000 hectares are considered available for timber production and harvesting under current management practices. In the area available for timber harvesting, the greater part of the forest is dominated by lodgepole pine, Douglas-fir, spruce, and balsam. Smaller areas are dominated by cedar, hemlock and deciduous species. Lodgepole pine, Douglas-fir, and spruce are the tree species most commonly used by the forest industry in the area.

The current allowable annual cut of the Kamloops TSA is 2 647 900 cubic metres per year, and consists of three components: a regular or conventional allowable harvest of 2 361 900 cubic metres; a partition of 200 000 cubic metres per year for old cedar and hemlock stands; and a partition of 86 000 cubic metres per year for Pulpwood Agreement 16. Given current management assumptions, the analysis shows that the conventional portion of the AAC can be maintained for the next 70 years, followed by a 5% decline to the long-term harvest level of 2 246 000 cubic metres per year. The analysis indicated that the partitioned harvests for old cedar and hemlock stands and Pulpwood Agreement 16 could be maintained for the remainder of the current obligations (10 and 15 years, respectively).

In the base case harvest forecast timber supply is 2 647 900 cubic metres per year over the first ten years, accounting for the 286 000 cubic metres of partitioned harvest. The second decade harvest is 2 447 900, accounting for the remainder of the existing term of Pulpwood Agreement 16 and the non-partitioned or conventional harvest.

The base case results reflect current knowledge and information on forest inventory, growth and yield, and management. However, uncertainties about several factors important in defining timber supply could affect the harvest flow.

Short-term timber supply (defined as the next 20 years) is sensitive to changes that influence the amount of timber available from existing unmanaged stands because the projected harvest relies on these stands almost entirely for the next 60 years, and to a lesser degree over the subsequent 30 years. In particular, any reductions in estimates of timber volumes from existing stands could have immediate negative impacts on short-term harvest flow.

Medium-term (21 to 80 years from now) timber supply is affected by uncertainties in visual management requirements, the size of the timber harvesting land base, minimum harvestable ages, green-up and forest cover requirements, and the rule used to set priorities for harvest scheduling, in addition to the factors that affect short-term supply.

Long-term timber supply (beyond 80 years from now) is affected by uncertainties in the estimates of regenerated stand yields, estimates of site productivity for old-growth stands, the availability of improved seeds from seed orchards, visual management requirements, the size of the timber harvesting land base, the rule used to set priorities for harvest scheduling, and to a lesser extent the contribution of forest outside the timber harvesting land base to biodiversity requirements.

Executive Summary

In conclusion, this analysis indicates that based on current inventory, growth and yield, and forest management information the Kamloops TSA, the existing timber supply from conventionally harvested stands of 2 361 900 cubic metres per year can be maintained for the next seventy years before declining by 5% to a long-term harvest level of 2 246 000 cubic metres per year, and the two partition harvests for old cedar/hemlock stands and for PA 16 can be maintained for the length of their current obligations.

The socio-economic analysis for the Kamloops TSA indicates that the current total AAC of 2 647 900 cubic metres, which comprises the conventional supply plus the partitions, can support a provincial total of approximately 2,500 person–years of direct employment. Residents of the Kamloops TSA account for approximately 92% of this direct employment. Total provincial direct employment associated with the Kamloops TSA forestry sector supports a further 2,700 person-years of indirect and induced employment across the province.

The base case harvest forecast indicates a stable timber supply. If harvests remain at the current level, they will provide stability for employment within the Kamloops TSA and help to maintain processing activity in the south-central portion of the province.

The estimated provincial government revenues that would be associated with the full harvest of the current AAC are approximately $97 million per year, and could remain at this level with the continuation of current stumpage and tax rates. Revenues from actual harvests from 1997-2000 averaged $94.8 million annually.

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Introduction

Timber supply* is the quantity of timber available for harvest over time. Timber supply is dynamic, not only because trees naturally grow and die, but also because conditions that affect tree growth, and the social and economic factors that affect the availability of trees for harvest, change through time.

Assessing the timber supply involves considering physical, biological, social and economic factors for all forest resource values, not just for timber. Physical factors include the land features of the area under study as well as the physical characteristics of living organisms, especially trees. Biological factors include the growth and development of living organisms. Economic factors include the financial profitability of conducting forest operations, and the broader community and social aspects of managing the forest resource.

All of these factors are linked: the financial profitability of harvest operations depends upon the terrain, as well as the physical characteristics of the trees to be harvested. Determining the physical characteristics of trees in the future requires knowledge of their growth. Decisions about whether a stand is available for harvest often depend on how its harvest could affect the growth and development of another part of the forest resource, such as wildlife or a recreation area.

These factors are also subject to both uncertainty and different points of view. Financial profitability may change as world timber markets change. Unforeseen losses due to fire or pest infestations will alter the amount and value of timber. The appropriate balance of timber and non-timber values in a forest is an ongoing subject of debate, and is complicated by changes in social objectives over time.

Thus, before an estimate of timber supply is interpreted, the set of physical, biological and socio-economic conditions on which it is based, and which define current forest management — as well as the uncertainties affecting these conditions — must first be understood. Timber supply analysis is the process of assessing and predicting the current and future timber supply for a management unit (a geographic area). For a timber supply area (TSA)*, the timber supply analysis forms part of the information used by the chief forester of British Columbia in determining an allowable annual cut (AAC)* — the permissible harvest level for the area.

Timber supply projections made for TSAs look far into the future — 250 years or more. However, because of the uncertainty surrounding the information and because forest management objectives change through time, these projections should not be viewed as static prescriptions that remain in place for that length of time. They remain relevant only as long as the information upon which they are based remains relevant. Thus, it is important that re-analysis occurs regularly, using new information and knowledge to update the timber supply picture. Indeed, the *Forest Act* requires that the timber supply for management units through British Columbia be reviewed at least every 5 years. This allows close monitoring of the timber supply and of the implications for the AAC stemming from changes in management practices and objectives.

**Throughout this document, an asterisk after a word or phrase indicates that it is defined in a box at the foot of the page, as well as in the glossary.*

Timber supply
The amount of timber that is forecast to be available for harvesting over a specified time period, under a particular management regime.
Timber supply area (TSA)
An integrated resource management unit established in accordance with Section 7 *of the* Forest Act.

Allowable annual cut (AAC)
The rate of timber harvest permitted each year from a specified area of land, usually expressed as cubic metres of wood per year.

Introduction

Timber supply analysis involves three main steps. The first is collecting and preparing information and data in which the B.C. Forest Service forest inventory* plays a major role. The second step is using this data along with a timber supply computer model or models* to make projections or estimates of possible harvest levels over time. These projections are made using different sets of assumed values or conditions for the factors discussed above. The third step is interpreting and reporting results.

The following sections outline the timber supply analysis for the Kamloops TSA. Following a brief description of the area in Section 1, data preparation and formulation of assumptions are discussed in Section 2. Timber supply analysis methodology and results are presented in Sections 3 and 4. Section 5 examines the sensitivity of the results to uncertainties in the data and assumptions used. This is followed by a summary and conclusions for the timber supply analysis. Section 7 shows results of a socio-economic analysis for the Kamloops TSA. Appendixes A and B contain further details about the data and assumptions used in the analysis.

As part of the timber supply review, information is gathered on the short- and long-term implications of alternative harvest levels, and the capabilities and requirements of existing and proposed processing facilities. The socio-economic analysis provides information for the chief forester and the local community to better understand the potential magnitude of impacts associated with any proposed harvest level changes.

Forest inventory
An assessment of British Columbia's timber resources. It includes computerized maps, a database describing the location and nature of forest cover, including size, age, timber volume, and species composition, and a description of other forest values such as recreation and visual quality.

Model
An abstraction and simplification of reality constructed to help understand an actual system or problem. Forest managers and planners have made extensive use of models, such as maps, classification systems and yield projections, to help direct management activities.

1 Description of the Kamloops Timber Supply Area

The Kamloops Timber Supply Area (TSA) is situated in south-central British Columbia and covers approximately 2.67 million hectares (including Wells Gray Provincial Park). The TSA extends from the Logan Lake area south of Kamloops north to Wells Gray Park, and is bounded by the Columbia Mountains to the east and the Cariboo/Chilcotin area to the west. The Kamloops TSA is one of four TSAs in the Kamloops Forest Region, and includes both the Kamloops and Clearwater Forest Districts (with the exception of Tree Farm Licences (TFL)* 35 and 18). The Kamloops TSA is administered by the Kamloops Forest District office in Kamloops and the Clearwater Forest District office in Clearwater.

According to the 1996 census, the population of the Kamloops TSA was 101,730, a 14% increase from 1991. Almost 80% of the TSA's residents live in the City of Kamloops. Other communities include Ashcroft, Avola, Cache Creek, Savona, Chase and Logan Lake in the south, and Barriere, Blue River, Clearwater, Little Fort and Vavenby in the north.

The topography of the Kamloops TSA is one of sharp contrasts, from dry, hot grasslands in the south, to wet areas and rugged mountains in the north. The Thompson River and its tributaries wind through the heart of the area, travelling southward and westward toward the confluence with the Fraser River. In the northern portion of the TSA, the North Thompson River is bounded by the high peaks of the Monashee and Cariboo Mountains. Wet to very wet conditions, with high snowfalls, are the norm. In the central portion, the mountains give way to high plateaus dissected by steep valleys and dotted with lakes and rivers. Moist conditions support mixed forests. Further south, the landscape continues to become drier and gentler, with rolling uplands and numerous lakes. The dense forests of the north and central areas give way to mixed pine-fir forests with grasslands in the southern valleys.

The forests of the Kamloops TSA are fairly diverse, reflecting the variety of topography and climate. Within the land base currently considered available for timber harvesting, Douglas-fir and lodgepole pine are the dominant species, but spruce, subalpine fir, cedar, hemlock and hardwoods also occur.

The total current allowable annual cut (AAC) in the Kamloops TSA is 2.679 million cubic metres, including woodlot licences*. This level was set by the chief forester effective March 12, 1996, and was an increase of about 11% from the previous level of 2.417 million cubic metres. The increase included a partition* of 200,000 cubic metres for harvesting in old cedar and hemlock stands, and a partition of 86 000 cubic metres for the harvest of previously unmerchantable types under Pulpwood Agreement (PA)* 16.

Since woodlot licences are administered separately from the TSA, the AACs and areas that have been allocated to woodlots are removed from the TSA. At the time this analysis was initiated, 31 280 cubic metres per year had been allocated to woodlot licences under the existing TSA AAC. When this amount is subtracted from the total apportioned AAC, the AAC currently attributable to the TSA base is 2 647 900 cubic metres. The AAC allocated to existing woodlot licences under the current AAC is less than the total apportioned to the woodlot licence program. Only allocated volumes and areas were deducted.

About 53% of the TSA land base (including Wells Gray Park) is considered productive forest land managed by the B.C. Forest Service (approximately 1.409 million hectares). Currently about 74% of this forested land base is considered available for harvesting (39% of the total TSA land base).

Tree farm licence (TFL)
Provides rights to harvest timber, and outlines responsibilities for forest management, in a particular area.
Woodlot licence
An agreement entered into under the Forest Act. *It allows for small-scale forestry to be practised in a described area (Crown and private) on a sustained yield basis.*

Partition
A portion of the AAC that is attributable to certain types of timber and/or terrain.
Pulpwood agreements
An agreement applying to a fixed geographic area that allows harvesting of timber below sawlog standards if mill residues suitable for the facility under the agreement are not available.

1 Description of the Kamloops Timber Supply Area

Figure 1. Map of the Kamloops Timber Supply Area, Kamloops Forest Region.

1 Description of the Kamloops Timber Supply Area

Significant changes that influence forest management have occurred since the last timber supply review was completed. Some of these changes include:

- implementation of the *Forest Practices Code (FPC)**, with respect to riparian reserves volume retained for wildlife tree* patches (WTP); and management for landscape-level biodiversity*.
- management direction from the Kamloops Land and Resource Management Plan (KLRMP)* and creation of several new parks;
- revision of the area subject to visual quality objectives (VQO)*;
- an increase in the estimate of unsalvaged losses*;
- use of a computer-based geographic information system (GIS) to allow application of constraints at a finer level; and
- a review of the methodology for removing areas lost to roads, trails and landings (RTL).

The Kamloops Land and Resource Management Plan (KLRMP) was approved by government in July 1995 and subsequently declared a Higher Level Plan (HLP)* under the *Forest Practices Code of B.C. Act*. The Kamloops LRMP Monitoring Table provides ongoing public involvement in the implementation of the plan. The timber supply review reflects land-use planning decisions regarding those forest practices that are implemented and those protected areas* that have approval from government.

The forests of the Kamloops TSA provide a wide range of forest land resources, including forest products (timber and non-timber, such as botanical forest products), recreation and tourism amenities, and significant wildlife habitat. Parks, recreation areas and other Crown lands provide the setting for a host of activities including camping, hiking, wildlife and scenic viewing, fishing, hunting, hang-gliding, boating, river rafting, mountain-biking, four-wheel driving, ATVing, snowmobiling, and downhill, heli- and cross-country skiing. Major highways pass through areas of exceptional natural scenery, providing easy access to national and provincial parks, such as Wells Gray Provincial Park and Jasper and Banff National Parks.

Forest Practices Code
Legislation, standards and guidebooks that govern forest practices and planning, with a focus on ensuring management for all forest values.
Wildlife tree
A standing live or dead tree with special characteristics that provide valuable habitat for conservation or enhancement of wildlife.
Landscape-level biodiversity
The Landscape Unit Planning Guide provides objectives for maintaining biodiversity at both the landscape level and the stand level. At the landscape level, guidelines are provided for the maintenance of seral stage distribution, patch size distribution and landscape connectivity.
Land and Resource Management Plan (LRMP)
A strategic, multi-agency, integrated resource plan at the subregional level. It is based on the principles of enhanced public involvement, consideration of all resource values, consensus-based decision making, and resource sustainability.

Visual quality objective (VQO)
Defines a level of acceptable landscape alteration resulting from timber harvesting and other activities. A number of visual quality classes have been defined on the basis of the maximum amount of alteration permitted.
Unsalvaged losses
The volume of timber killed or damaged annually by natural causes (e.g., fire, wind, insects and disease) that is not harvested.
Higher level plans
Higher level plans establish the broader, strategic context for operational plans, providing objectives that determine the mix of forest resources to be managed in a given area.
Protected area
A designation for areas of land and water set aside to protect natural heritage, cultural heritage or recreational values (may include national park, provincial park, or ecological reserve designations).

1 Description of the Kamloops Timber Supply Area

1.1 The environment

The Kamloops TSA includes nine biogeoclimatic zones* that range from dry, hot grasslands in the south, to low-elevation open forests and mid-elevation forested plateaus with lakes and wetlands, to rugged, high-elevation forested areas and alpine tundra in the north. The varied ecological features and unique nature of the area contribute to the high biodiversity* values found in this TSA.

The Bunchgrass (BG) zone is common in the arid, low-elevation basins of the Kamloops TSA, such as along the Thompson River, generally at elevations between 350 and 1000 metres. This zone is characterized by hot summers, cold winters and low precipitation that restrict the production of forests on these grasslands. Black cottonwood is found along the river floodplains and aspen copses are scattered throughout the landscape. Riparian areas*, including those around lakes, creeks and alkali ponds, are important components of this grassland ecosystem. The BG zone is one of the smallest zones in B.C.; however, it supports a tremendous diversity of wildlife, including several species of provincial or national significance due to their rarity or uniqueness.

The Ponderosa Pine (PP) zone occurs at low elevations in the Thompson River valley and the southern portion of the North Thompson River valley, generally between 400 and 950 metres. This zone is characterized by low annual precipitation, very warm summers and cool winters with light snow cover. Forests are often open and park-like, with a ponderosa pine canopy and an understory of grasses. Douglas-fir is common on moist sites, while black cottonwood occurs on floodplains. Forests of the PP zone are of limited commercial value but are used for cattle grazing particularly in early spring and late fall.

The Interior Douglas-fir (IDF) zone dominates the lower to middle elevations (350 to 1450 metres) and generally occurs above the PP and BG zones and below the Montane Spruce Zone. The IDF has warm, dry summers and cool winters, allowing a long growing season. Douglas-fir stands cover substantial portions of the zone, forming open or closed forests. Other less common tree species include lodgepole pine, ponderosa pine, white spruce and trembling aspen. Forestry is a very important resource use of this zone, as is cattle grazing. The diverse topography and vegetation in the IDF provide a wide variety of habitat niches for wildlife, including birds and fish.

The Interior Cedar-Hemlock (ICH) zone is located at lower to middle elevations (400 to 1450 metres) generally in the northern and central parts of the Kamloops TSA above the IDF zone. The ICH zone has wet, cool winters and warm, dry summers, and is the most productive forest zone in the interior of B.C. This zone has a wide diversity of tree species including western redcedar, western hemlock, Engelmann spruce, subalpine fir, Douglas-fir, lodgepole pine, birch and various poplar species. Forestry is a very important resource use in this zone, as is recreation. Bears and large ungulates* are found throughout the ICH.

The Montane Spruce (MS) zone occurs at middle elevations (1300 to 1650 metres) generally above the IDF zone and below the Engelmann Spruce-Subalpine Fir Zone (see below) in the southern half of the TSA. It is characterized by cold winters and moderately short, warm summers, and is a transition zone with climax stands of Douglas-fir and subalpine fir. One of the zone's most distinctive features is the extensive stands of young and maturing lodgepole pine that have formed in areas affected by wildfires. Forestry and cattle grazing are important resource uses in this zone. Lodgepole pine stands provide summer and fall range for moose and mule deer, and riparian areas are important summer habitats for a variety of wildlife species.

Biogeoclimatic zones
A large geographic area with broadly homogeneous climate and similar dominant tree species.
Biodiversity (biological diversity)
The diversity of plants, animals and other living organisms in all their forms and levels of organization, including the diversity of genes, species and ecosystems, as well as the evolutionary and functional processes that link them.

Riparian area
Areas of land adjacent to wetlands or bodies of water such as swamps, streams, rivers or lakes.
Ungulate
A hoofed herbivore, such as deer.

1 Description of the Kamloops Timber Supply Area

The Sub-Boreal Spruce (SBS) zone occurs at middle elevations (1000 to 1450 metres) of the central portions of the TSA on the Nehalliston Plateau, generally below the Engelmann Spruce-Subalpine Fir zone. The SBS is characterized by cold winters and cool summers, with moderate annual precipitation. Lodgepole pine is the leading tree species and other tree species include spruce, subalpine fir, aspen, birch, cottonwood and Douglas-fir.

The Sub-Boreal Pine Spruce (SBPS) zone occurs at middle elevations (1000 to 1350 metres) of the central portions of the TSA around Bonaparte Lake. The SBPS is characterized by cool winters and cool summers. Annual precipitation is moderate. Lodgepole pine and spruce are the leading tree species with minor components of Douglas-fir.

The Engelmann Spruce-Subalpine Fir (ESSF) zone is the uppermost forested zone in the Kamloops TSA, typically occurring between 1500 and 2050 metres, generally above the ICH, SBS or MS zones. The ESSF zone climate is characterized by short, cool growing seasons and long, cold winters. The major tree species are Engelmann spruce and subalpine fir, but lodgepole pine, western hemlock and western redcedar are also found. The ESSF is important wintering habitat for caribou, and avalanche tracks are important spring and summer habitats for bear and ungulates.

The Alpine Tundra (AT) zone occurs at the highest elevations, usually above 2000 metres in the south and 2200 metres in the north of the TSA, above the ESSF zone. The climate is cold, windy and snowy with a short, cool growing season. The AT is predominantly treeless, although stunted Engelmann spruce and subalpine fir trees are found at lower elevations of the zone. Vegetation is dominated by herbs, grasses, mosses, lichens and shrubs. Key mountain areas are noted for their beautiful floral displays, such as the Trophies, Baldy Mountain and Hat Creek peaks. Wildlife diversity and abundance are generally low in the AT zone.

The diverse forests of the Kamloops TSA host a wide variety of wildlife species including grizzly bear, black bear, moose, mule deer, goat, California bighorn sheep and marten. The TSA overlaps the range of a provincially important and viable herd of mountain caribou. Due to winter conditions, these caribou require sufficient canopy cover, provided by mature forests, to move between feeding areas, which requires attention during planning of forest development activities. The Kamloops TSA provides a migration corridor for the caribou that inhabit Wells Gray Park.

The TSA contains more than 1,800 lakes and 40 salmon-producing steams, as well as many additional fish-supporting steams. These waterbodies support some of the finest inland fisheries in B.C. Species of high recreational or economic value include rainbow trout, steelhead, kokanee, brook trout, white fish and Dolly Varden. The Thompson, North Thompson, South Thompson and Adams rivers and their tributaries support a significant population of anadromous fish — steelhead and sockeye, coho, chinook and pink salmon. The North Thompson River also contains most of the wild stocks of rainbow trout within the TSA.

Under the Kamloops LRMP, a process exists for identifying species at risk and developing specific management practices for them. The *Forest Practices Code* allows for the designation of wildlife habitat areas (WHA). Table 1 outlines species at risk that require management in the TSA. Thirty-two listed species are associated with grasslands and/or open forest (21 blue- and 11 red-listed).

1 Description of the Kamloops Timber Supply Area

Table 1. Species at risk in the Kamloops TSA

Forest wildlife species	Status	Grassland wildlife species	Status
Tailed frog (rare or not present)	Blue/Red	Western screech owl (*macfarlanei*)	Red
Rubber boa	Blue	Western grebe (rare or not present)	Red
Sharp-tailed snake (rare or not present)	Red	Swainson's hawk (rare)	Red
Sandhill crane	Blue	Ferruginous hawk (rare or not present)	Red
Flammulated owl	Blue	Prairie falcon	Red
Western screech owl (macfarlanei)	Red	Upland sandpiper (rare)	Red
Lewis' woodpecker	Blue	Burrowing owl	Red
Williamson's sapsucker (*thyroideus*)	Blue	Sage thrasher (rare or not present)	Red
Western small-footed myotis	Blue	Brewer's sparrow subsp. *breweri*	Red
Northern long-eared myotis	Blue	Lark sparrow	Red
Fringed myotis	Blue	Badger	Red
Wolverine (*luscus*)	Blue	Great basin spadefoot toad	Blue
Mountain caribou (southern pop.)	Blue	Painted turtle	Blue
Fisher	Blue	Gr. Basin. Gopher snake (*deserticola*)	Blue
Grizzly bear	Blue	Western Rattlesnake (*oreganus*)	Blue
Total: 15 species		American avocet	Blue
		Bobolink (rare)	Blue
		Great basin pocket mouse	Blue
		Bighorn sheep (*canadensis*)	Blue
		Bighorn sheep (*californiana*)	Blue
		Total: 32 species	

The *Managing Identified Wildlife: Procedures and Measures Volume 1 February 1999, Forest Practices Code* also provides some management direction for the red- and blue-listed species as well as direction for the northern goshawk.

Current forest management practices follow the legislation and guidelines set out by the *Forest Practices Code* and the Higher Level Plan of the Kamloops LRMP. Consequently, the protection of wildlife and the environment will be managed through this direction.

1 Description of the Kamloops Timber Supply Area

1.2 First Nations

The Secwepemc Nation, the Nlaka'pamux Nation, the St'at'imc Nation, the Okanagan Nation and the South Carrier Nation have traditional territories within the Kamloops TSA. Currently there are ten First Nation communities within the TSA with a population of about 4,500 people. These communities are Adams Lake, Bonaparte, Kamloops, North Thompson, Neskonlith, Skeetchestn, Whispering Pines, Little Shuswap, Ashcroft and Oregon Jack. Additional First Nations communities are located outside of the Kamloops TSA but maintain traditional interests inside the TSA. These include the High Bar, Spallumcheen, Lower Nicola, Upper Nicola, Xaxl'ip (Fountain), Ts'kw'aylaxw (Pavillion), Cooks Ferry, Lheidli T'enneh Nation and Canim Lake.

An archaeological overview assessment (AOA) was completed in 1995 as a component of the Kamloops LRMP process. The LRMP directs that areas rated in the AOA as having high and medium archaeological potential are to have archaeological assessments completed for operational planning.

First Nations people receive some employment opportunities in the forest industry; however, they have expressed concerns that they do not receive an equitable share of forest industry related employment. First Nations have also expressed concerns about the lack of meaningful consultation, and the impact of logging on water and fishery resources, traditional use areas, heritage resources and spiritual ceremonial sites in their traditional territories.

2 Information Preparation for the Timber Supply Analysis

Timber supply analysis requires three general categories of information: land base inventory; timber growth and yield; and management practices. In preparation for the analysis, a number of changes since the 1995 Kamloops TSA timber supply analysis were noted.

2.1 Land base inventory

Land base information used in this analysis came in a computer file compiled in 1997 by the B.C. Forest Service. This file contains information on the forest land in the Kamloops TSA including general geographic location, area, nature of forest cover (such as presence or absence of trees, species, number of trees, age, and timber volume), and other characteristics such as environmental sensitivity and physical accessibility (operability*). Stand attributes such as tree height, stocking* and age have been projected to January 1998. The inventory file has been updated to account for timber harvesting up to December 1996.

The inventory file represents the land base for the entire TSA. It includes information on land that does not contain forest, and other areas where timber harvesting is not expected to occur. Examples are land set aside for parks, areas needed to protect wildlife habitat, areas in utility and transportation corridors, and residential and industrial development. A description of the types of areas that do not contribute to the timber harvesting land base* of the Kamloops TSA is provided below. Before assessing timber supply, these non-contributing areas are identified and separated from the timber harvesting land base. When deriving this data file, care is taken to make only a single reduction for areas which overlap (for example, where an inoperable area* is also a low productivity site).

Identifying areas as not contributing to timber supply does not mean the area is removed from the Kamloops TSA. The B.C. Forest Service still manages the entire area of the TSA (except for designated areas under the jurisdiction of other agencies) as a land unit that contributes a mix of timber and non-timber values. The timber supply is managed within this integrated resource context, and the analysis described herein is consistent with this philosophy.

This section describes the types of areas that do not contribute to the timber harvesting land base. The term timber harvesting land base in this report does not mean the area is open to unrestricted logging. Rather, it implies that forests in the area contain timber of sufficient economic value, and sites of adequate environmental resilience to accommodate timber harvesting with due care for other resources.

For the Kamloops TSA, the following types of areas were excluded from the timber harvesting land base.

- not managed by the B.C. Forest Service — these are non-Crown areas such as private land and Indian Reserves, and Crown areas such as parks. Crown forested areas which do not contribute to harvests continue to contribute towards biodiversity and other resource values.
- non-forest areas — areas not occupied by productive forest cover (e.g., rock, swamp, alpine areas and water bodies).

Operability
Classification of an area considered available for timber harvesting. Operability is determined using the terrain characteristics of the area as well as the quality and quantity of timber on the area.
Stocking
The proportion of an area occupied by trees, measured by the degree to which the crowns of adjacent trees touch, and the number of trees per hectare.

Timber harvesting land base
Crown forest land within the timber supply area where timber harvesting is considered both acceptable and economically feasible, given objectives for all relevant forest values, existing timber quality, market values and applicable technology.
Inoperable areas
Areas defined as unavailable for harvest for terrain-related or economic reasons. Characteristics used in defining inoperability include slope, topography (e.g., the presence of gullies or exposed rock), difficulty of road access, soil stability, elevation and timber quality. Operability can change over time as a function of changing harvesting technology and economics.

- non-commercial cover areas — areas occupied by non-commercial tree or brush species.
- inoperable areas — areas classified as unavailable for harvest for terrain-related reasons. Characteristics used to define operability include slope, topography (e.g., presence of gullies or exposed rock), difficulty of road access, soil stability and elevation.
- non-merchantable forest types* — stands which are physically operable and exceed low site criteria yet are not currently utilized or have marginal merchantability, including deciduous*-leading stands outside Pulpwood Agreement (PA) 16.
- sites with low timber productivity — areas occupied by forest with low timber-growing potential.
- existing roads, trails and landings (RTL) — areas of forest land that have been removed from timber production due to access development and harvesting to date.
- environmentally sensitive areas (ESA)* —areas with sensitive soils, high recreation and water values, and potential regeneration or avalanche problems.
- riparian reserve zone area —areas that are unavailable for harvesting to provide protection for riparian and stream ecosystems.
- wildlife tree patch areas — areas reserved within and along the edges of cutblocks* for the maintenance of stand-level biodiversity* (stand structure), primarily for conservation or enhancement of wildlife.

A more detailed description of these categories, including specific criteria for removal is located in Appendix A, "Description of Data Inputs and Assumptions for the Timber Supply Analysis." Table 2 summarizes the areas in each category, and shows the area of the timber harvesting land base.

The current timber harvesting land base in the Kamloops TSA represents about 39% of the total TSA area and about 74% of the productive forest. The three categories that most reduce the availability of the productive forest for timber supply are: inoperable areas (6.8%), environmentally sensitive areas (7.7%) and non-merchantable, deciduous, or low sites stands (total of 8.2%). The remaining categories, including riparian areas and existing roads, represent slightly over 3% of the productive forest. The percentages provided depend on the order in which each category is considered. For instance, riparian areas would constitute a larger proportion of the reduction if they were considered prior to inoperable areas.

Non-merchantable forest types
Stands that are accessible and otherwise available for harvesting but are assumed to be non-merchantable due to stand characteristics such as small piece size, incidence of decay, species composition and low stocking.
Deciduous
Deciduous trees shed their leaves annually and commonly have broad-leaves.

Environmentally sensitive areas
Areas with significant non-timber values, fragile or unstable soils, impediments to establishing a new tree crop, or high risk of avalanches.
Cutblock
A specific area, with defined boundaries, authorized for harvest.
Stand-level biodiversity
A stand is a relatively localized and homogeneous land unit that can be managed using a single set of treatments. In stands, objectives for biodiversity are met by maintaining specified stand structure (wildlife trees or patches), vegetation species composition and coarse woody debris levels.

2 Information Preparation for the Timber Supply Analysis

Table 2. Determination of the timber harvesting land base for the Kamloops TSA

Classification	Area (hectares)	Per cent (%) of total area	Per cent (%) of productive forest area
Total area	2 666 375	100.0	
Wells Gray Provincial Park[a]	528 000	19.8	
Other areas not managed by B.C. Forest Service	364 894	13.7	
Non-forest	364 371	13.7	
Total productive forest land managed by the BCFS[b]	**1 409 110**	**52.8**	**100.0**
Reductions to Crown forest			
Non-commercial brush	2 466	0.1	0.2
Inoperable	95 709	3.6	6.8
Environmentally sensitive	108 967	4.1	7.7
Deciduous	37 878	1.4	2.7
Sites with low timber growing potential	31 141	1.2	2.2
Non-merchantable stands	45 938	1.7	3.3
Riparian	21 841	0.8	1.5
Hudson's Bay Trail	103	0.0	0.0
Tod Mountain	159	0.0	0.0
Community watershed (CWS) intakes	2	0.0	0.0
Existing roads	24 045	0.9	1.7
Total current reductions	**368 250**	**13.8**	**26.1**
Current timber harvesting land base[c] (including not satisfactorily restocked (NSR)* area)	**1 040 860**	**39.0**	**73.9**
Future roads, landings, and trails	47 434	1.8	3.4
Long-term timber harvesting land base	**993 426**	**37.3**	**70.5**

(a) Wells Gray Provincial Park is situated within the northwestern portion of the Kamloops TSA. Since the park is almost entirely contained in a landscape unit, it does not contribute to biodiversity objectives in this analysis.

(b) The total forested area that contributes to landscape-level biodiversity objectives in the Kamloops TSA is approximately 1 482 700 hectares, which includes some land not managed by the B.C. Forest Service

(c) The current timber harvesting land base includes the areas subject to partitions for old cedar and hemlock (49 744 hectares) and for Pulpwood Agreement (PA) 16 (84 283 hectares). Upon expiry of the partitions, unharvested areas, according to modelling results, 40 700 and 73 100 hectares respectively, do not contribute directly to the timber harvests over the long term. These areas are, however, included in the long-term timber harvesting land base in the table. Excluding the area would result in a long-term timber harvesting land base of 879 626 hectares.

Not satisfactorily restocked (NSR) areas
An area not covered by a sufficient number of well-spaced tree stems of desirable species. Stocking standards are set by the B.C. Forest Service. Areas harvested prior to October 1987 and not yet sufficiently stocked according to standards are classified as backlog NSR. Areas harvested or otherwise disturbed since October 1987 are classified as current NSR.

2 Information Preparation for the Timber Supply Analysis

Figure 2 represents both the total area of the Kamloops TSA, and the productive forest land base. The total area chart shows that almost 20% of the area is covered by Wells Gray Provincial Park. About 13.7% of the total land base is classified as not managed by B.C. Forest Service, and the same percentage is non-forest or non-productive forest (i.e., having very few trees) managed by the Forest Service. The productive forest chart details the categories of forest land and shows that about 73.9% of the forest land in the Kamloops TSA is considered to be available for timber harvesting (including NSR) over time.

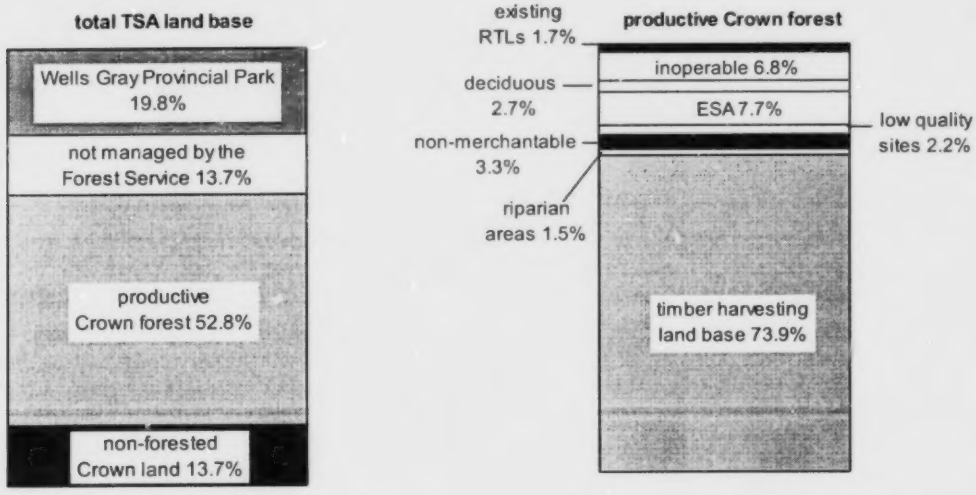

Figure 2. Composition of the total and productive forest land bases — Kamloops TSA, 2001.

2 Information Preparation for the Timber Supply Analysis

Figure 3 shows the current composition of the timber harvesting land base by dominant tree species. Lodgepole pine dominates stands on 30.7% of the timber harvesting land base, with Douglas-fir species on moister sites dominating 18%. Douglas-fir species on drier sites, where selection and small-patch harvesting is expected, dominate 15.9% of the timber harvesting land base. Stands prevalent in spruce and balsam, cover 27.6% of the area, while the area of timber harvesting land base with cedar and hemlock stands is only 7.0%. Deciduous stands expected to be harvested under Pulpwood Agreement 16 make up 0.9% of the timber harvesting land base. After harvest, stands are expected to be regenerated as described in Appendix A, "Description of Data Inputs and Assumptions for the Timber Supply Analysis."

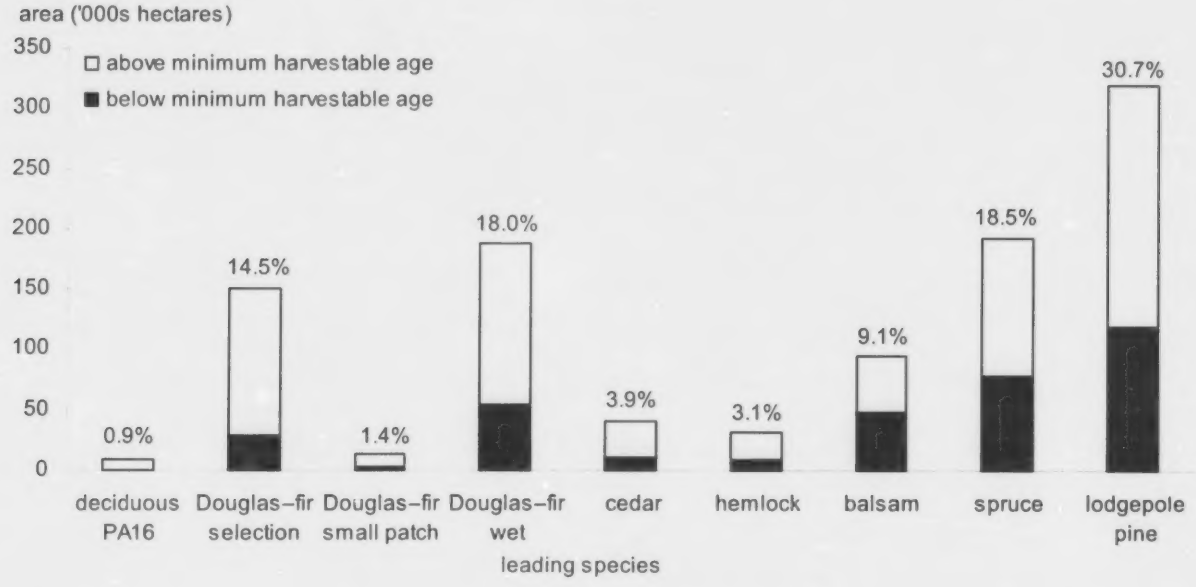

Figure 3. Area by dominant species — Kamloops TSA timber harvesting land base, 2001.

Figure 3 also shows the proportion of area of each species that is either younger or older than the minimum harvestable age (MHA) for existing forests (see Appendix A, "Description of Data Inputs and Assumptions for the Timber Supply Analysis" for details on the minimum harvestable age for each species). In total, about 66% of stands in the timber harvesting land base are at or above the applicable minimum harvestable age. This proportion varies among the species groupings: 63% of lodgepole pine stands, 71% of Douglas-fir stands on wetter sites, 74% of cedar or hemlock stands, 81% of Douglas-fir stands on drier sites, 49% of balsam, and 59% of spruce stands are currently older than their minimum harvestable ages.

2 Information Preparation for the Timber Supply Analysis

Figure 4 provides an overview of the distribution of site productivity of the dominant stand types within the timber harvesting land base. The site classes referenced in Figure 4 group stands by site index (SI)* range (height at age fifty years). Stands classified as 'poor' or 'low' site class cover 25% of the timber harvesting land base, while stands with a site class of 'medium' occupy 46% of the area, and those with a site class value of 'good' cover 29%. The area-weighted average site index for the timber harvesting land base is 15.5. For stands older than 140 years of age, the area-weighted average site index is 13.3.

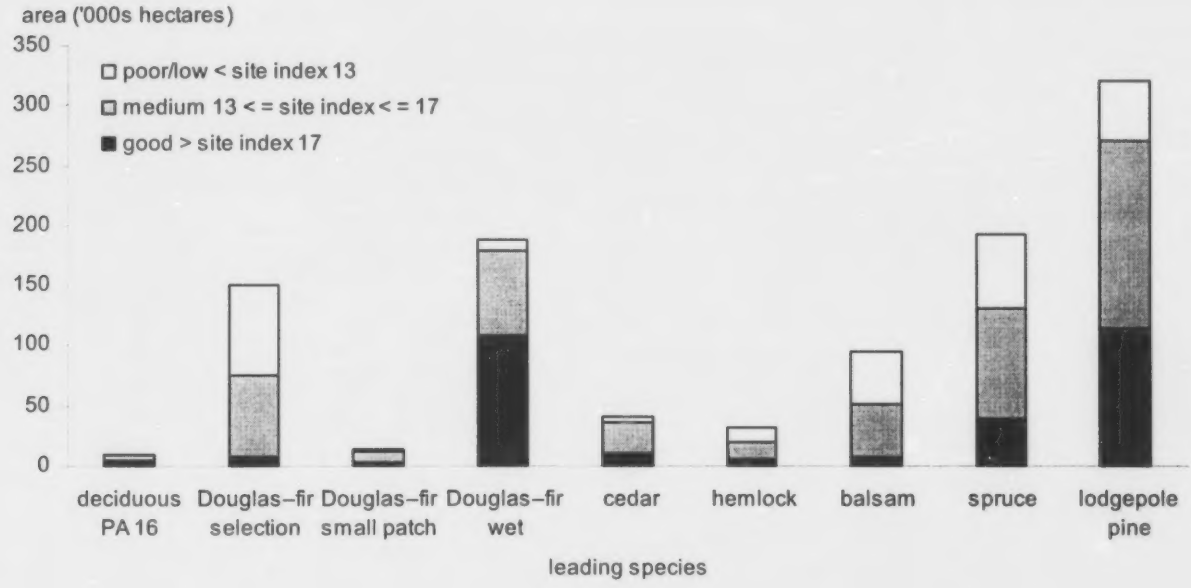

Figure 4. Area by site class — Kamloops TSA timber harvesting land base, 2001.

Site index
A measure of site productivity. The indices are reported as the average height, in metres, that the tallest trees in a stand are expected to achieve at 50 years (age is measured at 1.3 metres above the ground). Site index curves have been developed for British Columbia's major commercial tree species.

2 Information Preparation for the Timber Supply Analysis

Figure 5 shows the current age composition of forested stands in the Kamloops TSA. Within the timber harvesting land base, about 7% of the stands are older than 250 years. About 11% of stands are 20 years or younger, 59% are between 21 and 140 years old, and 22% are between 141 and 250 years of age.

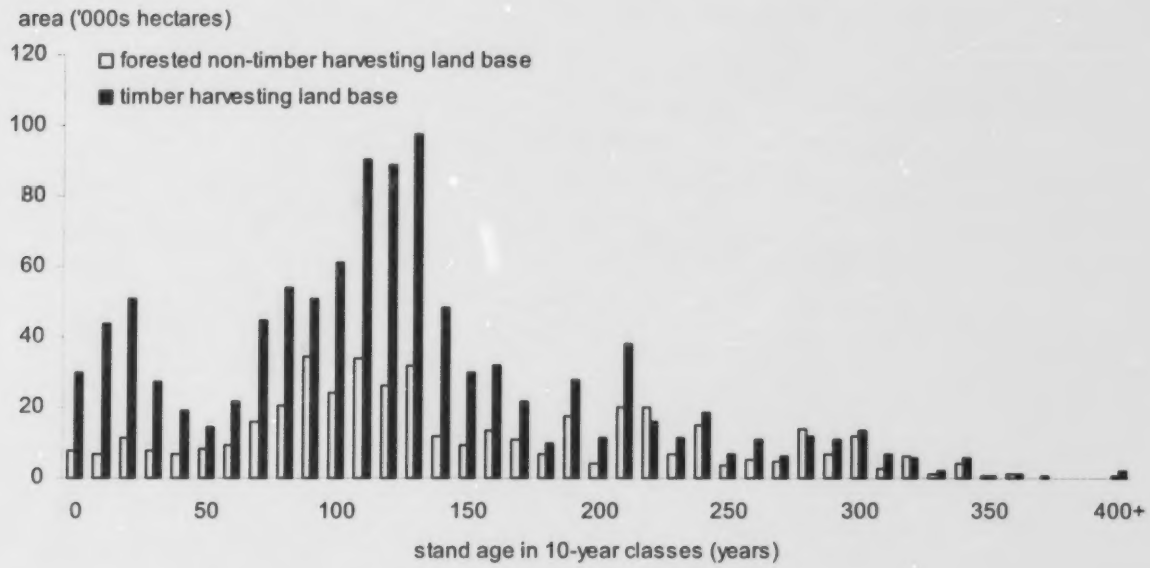

Figure 5. Current age class composition — Kamloops TSA productive forest land base, 2001.

The age class distribution of forested stands excluded from the timber harvesting land base also affects timber supply. Although they do not contribute directly to the timber supply, these areas can provide old-forest and biodiversity attributes, and therefore affect how much harvesting can be conducted and the pattern of the harvesting within the TSA. In the Kamloops TSA, a significant portion of forest is outside of the timber harvesting land base (the 'non-timber harvesting land base'). Of the total forested area that contributes to forest management objectives—approximately 1 482 700 hectares (which includes some land not managed by the B.C. Forest Service) — 30% (441 900 hectares) are outside of the timber harvesting land base. About 13% (58 700 hectares) of these non-timber harvesting land base stands are older than 250 years. Only 4% of the stands are 20 years or younger, and 30% are between 141 and 250 years of age.

In the longer term, the non-timber harvesting land base may be able to provide a significant amount of the area needed to meet old-forest biodiversity requirements as set out in the Kamloops Land and Resource Management Plan (KLRMP). However, some old forest in the timber harvesting land base will have to be reserved from harvesting into the medium term while forests in the non-timber harvesting land base age sufficiently to achieve old-forest conditions.

2 Information Preparation for the Timber Supply Analysis

2.2 Timber growth and yield

Timber growth and yield refers to the prediction of the growth and development of forest stands over time. Forest stands have many characteristics that change over time and could be the subject of growth and yield (for example, number of trees per area, tree diameter, tree height, species composition). Timber supply analysis concentrates on timber volume per area measured in cubic metres per hectare. An estimate of timber volume in a stand assumes a specific utilization level, or set of dimensions, that establishes the minimum tree and log sizes that are removed from a site. Utilization levels used in estimating timber volumes specify minimum diameters both near the base and the top of a tree.

Two growth and yield models were used to estimate timber volumes for the Kamloops TSA analysis. The variable density yield prediction (VDYP)* model developed by the B.C. Forest Service, Resources Inventory Branch, was used for estimating volumes in unmanaged coniferous* and deciduous stands. Managed deciduous stand volumes were also assigned using VDYP volume estimates*. The table interpolation program for stand yields (TIPSY)*, developed by the B.C. Forest Service, Research Branch, was used to estimate yields for coniferous managed stands. TIPSY was also used to estimate yields from stands that were harvested in the past but managed to current standards. Depending on the species, these stands may be as old as 25 years of age.

Volume estimation and prediction are subject to uncertainty due to uncertainties in inventories which form the basis for estimating site productivity, limited experience with second growth in British Columbia, and the long time frame over which trees grow. Sensitivity analyses described in Section 5, "Timber Supply Sensitivity Analyses," address the possibility that actual timber volumes may be different from estimates used in this analysis.

Based on timber volume estimates, the current timber inventory on the timber harvesting land base is approximately 184 million cubic metres. About 170 million cubic metres, or 92%, of the total is currently merchantable; that is, older than minimum harvestable age.

2.3 Management practices

Timber supply depends directly on how the forest is managed for both timber and non-timber values. Therefore, levels of management activity must be defined for the timber supply analysis process. The *Forest Practices Code of British Columbia Act* and associated regulations and the Kamloops Land and Resource Management Plan (KLRMP) guide forest management practices in the Kamloops TSA. The focus of the Timber Supply Review is to assess timber supply based on current management practices as implemented in plans for the area. Current management is described in Appendix A, "Description of Data Inputs and Assumptions for the Timber Supply Analysis." Staff in the Kamloops and Clearwater Forest Districts provided information for the following management practices:

- Silviculture practices — reforestation activities required to establish free-growing* stands of acceptable tree species.

Variable Density Yield Prediction model
An empirical yield prediction system supported by the B.C. Forest Service, designed to predict average yields and provide forest inventory updates over large areas (i.e., Timber Supply Areas). It is intended for use in unmanaged natural stands of pure or mixed composition.
Coniferous
Coniferous trees have needles or scale-like leaves and are usually 'evergreen'.
Volume estimates (yield projections)
Estimates of yields from forest stands over time. Yield projections can be developed for stand volume, stand diameter or specific products, and for empirical (average stocking), normal (optimal stocking) or managed stands.

Table Interpolation Program for Stand Yields
A B.C. Forest Service computer program used to generate yield projections for managed stands based on interpolating from yield tables of a model (TASS) that simulates the growth of individual trees based on internal growth processes, crown competition, environmental factors and silvicultural practices.
Free-growing
An established seedling of an acceptable commercial species that is free from growth-inhibiting brush, weed and excessive tree competition.

- Incremental silviculture —planting of genetically improved stock* and stand thinning.
- Forest health and unsalvaged losses — timber losses to fire, wind and pest (insect) damage. The unsalvaged portion of damaged timber is estimated to be 62 600 cubic metres per year.
- Utilization levels — minimum sizes of trees, and logs to be removed during harvesting.
- Minimum harvestable ages (MHA) — the time it takes for stands to grow to a merchantable condition. These were based on district priorities, age-volume yield tables and input from local forest industry representatives. Actual harvestable age may be greater but not less than the minimum, and will depend on ages of other available stands, forest cover objectives* and overall timber harvest targets.
- Cutblock adjacency* and green-up* — in the Kamloops TSA, approval of harvesting activities is contingent on previously harvested stands reaching a desired condition, or green-up, before adjacent stands may be harvested. The purpose of the cutblock adjacency guidelines is to prevent timber harvesting from becoming overly concentrated in an area at any time. These guidelines were modelled by limiting the area of the timber harvesting land base in the standard resource management zone that does not meet green-up conditions to a maximum of 33%.
- Ungulate winter range (UWR) — to provide ungulates with acceptable winter cover and forage, forest cover requirements are applied to limit the area in early-seral* stages (maximum 20% of forested area below 3 metres), and provide a minimum amount of mature forest (minimum 25% older than 75 years).
- Protection of environmentally sensitive areas (ESA) — where hazardous terrain or sensitive soils have been identified. To protect soils and maintain ecological or other resource values, land has been wholly removed from the timber harvesting land base.
- Community watersheds* — within designated watersheds a maximum of 25% of the forest area may be less than 6.6 metres in height at any given time. Community watersheds cover 59 000 hectares, or 6%, of the timber harvesting land base.

Improved stock
Trees selected from the natural population with better than average characteristics such as growth rates.

Forest cover objectives
Specify desired distributions of areas by age or size class groupings. These objectives can be used to reflect desired conditions for wildlife, watershed protection, visual quality and other integrated resource management objectives. General adjacency and green-up guidelines are also specified using forest cover objectives (see ***Cutblock adjacency*** *and* ***Green–up****).*

Cutblock adjacency
The desired spatial relationship among cutblocks. Most adjacency restrictions require that recently harvested areas must achieve a desired condition (green-up) before nearby or adjacent areas can be harvested. Specifications for the maximum allowable proportion of a forested landscape that does not meet green-up requirements are used to approximate the timber supply impacts of adjacency restrictions.

Green-up
The time needed after harvesting for a stand of trees to reach a desired condition (usually a specific height) — to ensure maintenance of water quality, wildlife habitat, soil stability or aesthetics — before harvesting is permitted in adjacent areas.

Early seral
Stands are defined as early seral if they are younger than 40 years of age. An exception is deciduous-dominated stands in the Boreal White and Black Spruce biogeoclimatic zone, which are defined as early seral up to 20 years of age.

Watershed
An area drained by a stream or river. A large watershed may contain several smaller watersheds.

- Maintenance of scenic values — maintaining important scenic values requires that visible evidence of harvesting must be kept within limits in designated areas of the Kamloops TSA. The maximum proportion of each scenic area* that may be covered by young stands that do not meet visually effective green-up (VEG) requirements varies between 1% and 27.5% depending on the forest characteristics, visual quality objective (VQO) and visual absorption capability (VAC) for each area. Areas managed for visual quality occur on 39% of the timber harvesting land base.
- Caribou habitat — caribou management occurs in three types of habitat that primarily occupy the northern portions of the Kamloops TSA: early winter habitat, late winter habitat, and caribou corridors. These habitats are managed over about 11% of the timber harvesting land base. The management regimes modelled in this analysis consist of a mix of forest cover requirements that limit the area in early-seral stages* and provide a minimum amount of mature forest.
- Landscape-level biodiversity — to maintain biological diversity throughout a landscape unit (LU)* the *Forest Practices Code* contains targets for the proportion of the area in each biogeoclimatic variant* that should be covered by stands with old-forest characteristics. Within the Kamloops TSA, landscape-level biodiversity is guided by the KLRMP in its capacity as a Higher Level Plan under the *Forest Practices Code*. Old forest is defined as greater than 250 years old in natural disturbance types (NDTs)* 1, 2, and 4 and older than 140 years in NDT 3. Since landscape units and biodiversity emphasis options (BEO) have been recommended by the KLRMP, these values were used in the analysis.
- Harvest systems —clearcut and selection harvesting are employed in the Kamloops TSA.

The data package for the Kamloops Timber Supply Area (TSA) was released in November, 1998. As a result of public input, changes were made to the data package. The revised data package, which includes detailed descriptions of the management practices and the assumptions used to incorporate them into the analysis, is presented in Appendix A, "Description of Data Inputs and Assumptions for the Timber Supply Analysis" of this document.

Scenic area
Any visually sensitive area or scenic landscape identified through a visual landscape inventory or planning process carried out or approved by a district manager.
Seral stages
Sequential stages in the development of plant communities that successively occupy a site and replace each other over time.
Landscape unit
A planning area based on topographic or geographic features, that is appropriately sized (up to 100 000 hectares), and designed for application of landscape-level biodiversity objectives.

Biogeoclimatic (BEC) variant
A subdivision of a biogeoclimatic subzone. Variants reflect further differences in regional climate and are generally recognized for areas slightly drier, wetter, snowier, warmer or colder than other areas in the subzone.
Natural disturbance type (NDT)
An area that is characterized by a natural disturbance regime, such as wildfires, which affects the natural distribution of seral stages. For example areas subject to less frequent stand-initiating disturbances usually have more older forests.

2 Information Preparation for the Timber Supply Analysis

Figure 6 shows the proportions of the forested land base and the timber harvesting land base subject to management for scenic values, community watershed considerations, ungulate winter range and caribou habitat. Often, more than one management objective is applied to the same area; for example, all or part of a visual quality area may also be managed as a community watershed. In such a case, the area is required to meet all of the management objectives. The bar charts show the total area in each management emphasis area.

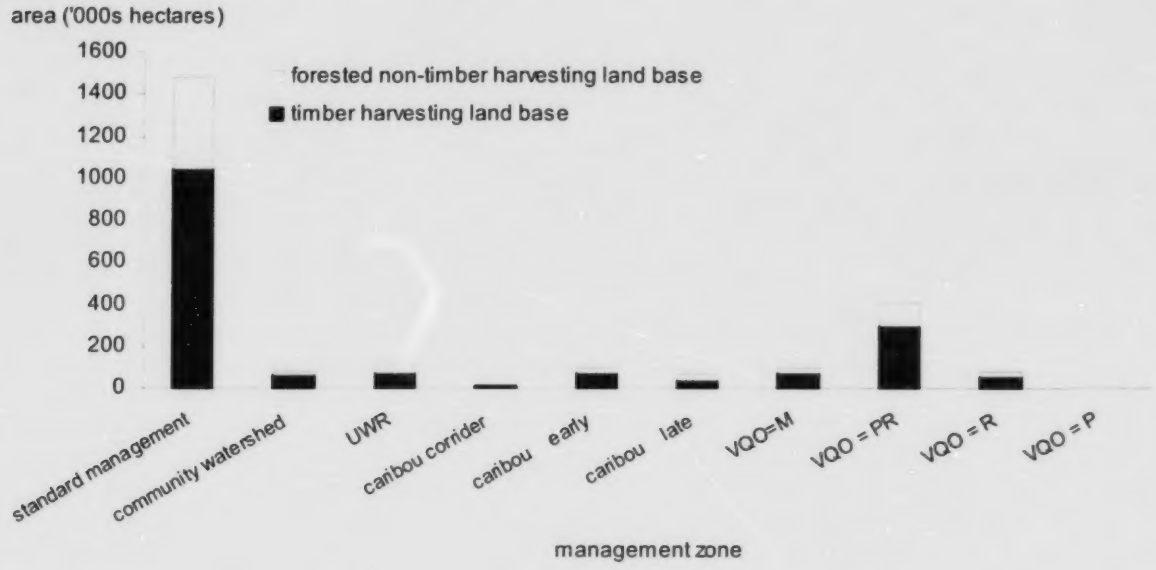

Figure 6. Forest management zones — Kamloops TSA forested land base, 2001.

2 Information Preparation for the Timber Supply Analysis

Figure 7 shows the distribution of the land base by biogeoclimatic (BEC) variant. The figure also shows the proportion of the total forest area in each BEC variant that is part of the timber harvesting land base. For example, slightly more than half of the total forested area in the ESSFwc2 variant is in the timber harvesting land base, while about four-fifths of the MSdm2 forest is in the timber harvesting land base.

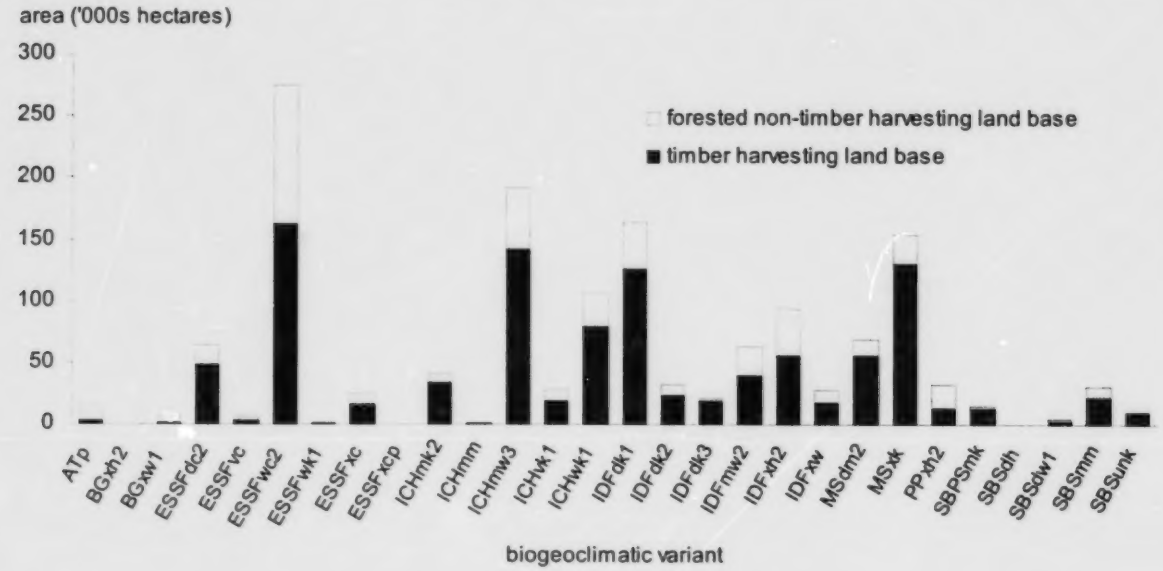

Figure 7. Area by biogeoclimatic classification — Kamloops TSA, 2001.

2.4 Changes since the 1995 Kamloops TSA analysis

Management practices, the size and availability of the timber harvesting land base, and modelling capabilities have changed since the last analysis for the Kamloops TSA. This section presents the major changes to the land base and forest management assumptions* since the last analysis.

In the last analysis the productive forested area considered in the Kamloops TSA timber supply analysis was 1 441 118 hectares. For this analysis, the area of productive forest managed by the Forest Service has decreased to 1 409 110 hectares, due primarily to the creation of several parks as part of the Kamloops LRMP, which was approved in 1995. However, the area of productive forest included in the analysis has increased to about 1 482 740 hectares, due mostly to the inclusion of parklands for their contribution to biodiversity objectives.

The AAC for the last analysis was 2 393 180 cubic metres per year. For this analysis, including partitions related to Pulpwood Agreement 16 (86 000 cubic metres per year) and old cedar and hemlock stands (200 000 cubic metres per year), and excluding the increased allowable harvest for the woodlot program (31 280 cubic metres per year) has increased the total AAC to 2 647 900 cubic metres per year.

The timber harvesting land base has also changed since the last analysis. In the previous analysis the initial timber harvesting land base was 950 832 hectares. It is now 1 040 860 hectares, an increase of 90 000 hectares or 9.5%. While the creation of several parks removed area from the timber harvesting land base, the inclusion of old hemlock stands, as well as explicitly modelling the contribution of Pulpwood Agreement 16 has increased the timber harvesting land base significantly.

> ***Management assumptions***
> *Approximations of management objectives, priorities, constraints and other conditions needed to represent forest management actions in a forest planning model. These include, for example, the criteria for determining the timber harvesting land base, the specification of minimum harvestable ages, utilization levels, integrated resource guidelines and silviculture and pest management programs.*

2 Information Preparation for the Timber Supply Analysis

Implementation of the *Forest Practices Code* has refined the definition of land base reserved from harvesting in riparian reserves, and volume retained for wildlife tree patches (WTPs). Constraints limiting the availability of the timber harvesting land base are the requirements to maintain or recruit suitable areas of old forest for landscape-level biodiversity.

Use of a computer-based geographic information system (GIS) has allowed for application of constraints at a finer level than was achievable in the last analysis.

Riparian buffers are now represented on an area specific basis rather than as a general percentage area exclusion.

The area subject to visual quality objectives (VQO) in this analysis is larger than in the last analysis due to availability of digital data. In this analysis, constraints were applied to individual polygons with one of twelve distinct forest cover constraints. In the last analysis, a single forest cover constraint was applied to a single, average polygon that represented all visual management areas in the TSA.

The estimate of unsalvaged losses has increased by 19 200 cubic metres per year relative to the last analysis. This increase is attributable to new information for calculating these losses.

A review of the methodology for removing areas lost to roads, trail and landings has reduced the areas removed for both existing and future roads, trail, and landings.

In summary, the timber harvesting land base has increased by 9.5%, corresponding largely to inclusion of forest land for harvests partitioned in the previous AAC determination, but not included in the last timber supply analysis. Inclusion of the partitioned harvests and adjustments for woodlot AACs has resulted in a net increase in the AAC attributable to the TSA by 10%. Finally, new data have become available, and some modelling assumptions have changed (e.g., more spatially explicit modelling of visual management and riparian areas) since the last analysis. Given the extent of these changes, direct comparisons between this and the previous analysis cannot be made. Each analysis needs to be evaluated in the context of the management regime and related data inputs and assumptions that applied at the time. As noted in the introductory section, there is uncertainty surrounding information used in analyses, and forest management objectives change over time, which is why the *Forest Act* requires the chief forester to periodically review the timber supply and AAC for each TSA.

Any changes to the land base or management assumptions that may occur or become effective after the completion of this timber supply analysis will be presented to the chief forester for consideration during the AAC determination.

3 Timber Supply Analysis Methods

The purpose of this analysis is to examine both the short- and long-term timber harvesting opportunities in the Kamloops TSA, in light of current forest management practices. A timber supply computer simulation model developed by the B.C. Forest Service was used to aid in the assessment (FSSIM version 3.0). A timber supply model, as distinct from a growth and yield model, assists the timber supply analyst in determining how a whole forest (collection of stands) could be managed to obtain a harvest forecast* (supply of timber over time). The simulation model uses information about the timber harvesting land base, timber volumes and the management regime to represent how trees grow and are harvested over a long period of time. Generally, only the results for the first 250 years are shown graphically in this report because the harvest level remains constant after that time.

Similar to other models, the B.C. Forest Service model assumes that trees grow according to provided yield projections, and are harvested according to either a volume target or a specified objective set by the analyst. The Forest Service model also allows the use of forest cover guidelines that specify the desired age composition of the forest. These guidelines can be used to examine the effects of green-up and old-forest prescriptions. For example, guidelines might specify that no more than some maximum percentage of the forest can be younger than a specified green-up age or that some minimum percentage of the forest must be in older age classes to provide wildlife habitat. The B.C. Forest Service simulation model facilitates examination of the effects of such guidelines on timber supply.

This type of analysis is used to determine the timber supply implications of a particular timber harvesting regime. The results of the analysis are especially important in determining allowable cuts that will not restrict options of future resource managers, and that will assist local B.C. Forest Service staff to administer their programs according to relevant guidelines and principles. However, the results of the analysis are not meant to be taken as recommendations of any particular AAC.

The main results of the analysis are forecasts of potential timber harvests and timber inventory changes (ages and volumes) over time. Although this information gives field staff only very limited guidance in the design of operational activities such as harvesting block location and silviculture planning, it does help ensure that the timber harvest level supports sustainable forest management in the field.

Harvest forecast
The flow of potential timber harvests over time. A harvest forecast is usually a measure of the maximum timber supply that can be realized over time for a specified land base and set of management practices. It is a result of forest planning models and is affected by the size and productivity of the land base, the current growing stock, and management objectives, constraints and assumptions.

4 Results

This section presents results of the timber supply analysis for the Kamloops TSA. The base case harvest forecast* is based on the most recent assessments of current forest management, timber yields and the land available for timber harvesting, as described in Section 2, "Information Preparation for the Timber Supply Analysis." Given the long-term nature of forest management, uncertainty surrounds much of the information important in determining timber supply. This uncertainty will be discussed in Section 5, "Timber Supply Sensitivity Analyses." The base case provides only a part of the timber supply picture for the Kamloops TSA, and should not be viewed in isolation of the sensitivity analysis*.

Section 2.4, "Changes since the 1995 Kamloops TSA analysis," provides an overview of the major changes to the land base and management assumptions since the last analysis. Any comparison between this and the last analysis should be made with recognition of the extent and nature of those changes. Each analysis should be evaluated in the context of the management regime and related data inputs and assumptions that applied at the time. One of the major reasons the chief forester is required under the *Forest Act* to periodically review the timber supply and AAC is to account for changes in management, and new or updated information that may resolve some uncertainties.

Base case harvest forecast
The timber supply forecast which illustrates the effect of current forest management practices on the timber supply using the best available information, and which forms the reference point for sensitivity analysis.

Sensitivity analysis
A process used to examine how uncertainties about data and management practices could affect timber supply. Inputs to an analysis are changed, and the results are compared to a baseline or base case.

4 Results

4.1 Base case harvest forecast

The base case harvest forecast for the Kamloops TSA reflects the implications of current management within the Kamloops and Clearwater Forest Districts. Figure 8 shows the base case harvest forecast for the Kamloops TSA. The projected timber supply during the first decade comes from stands that have conventionally been harvested in the TSA (2 361 900 cubic metres per year), the partition for old cedar/hemlock (200 000 cubic metres per year), and the Pulpwood Agreement (PA) 16 partition (86 000 cubic metres per year). In the second decade, the projected harvest comprises the conventional harvest and the PA 16 partition, while timber supply in the third decade is made up solely of the conventional harvest. The times over which the partition harvests are maintained reflect the lengths of the respective licence agreements: 10 years for old cedar/hemlock; and 15 years for PA 16 (for simplicity, 20 years was used in the analysis for PA 16). For the base case, the land base associated with these partitions (about 53 500 hectares of old cedar/hemlock and 84 000 hectares for PA 16) was no longer available for harvest after the expiry of the partition or agreement. Section 5.2, "Uncertainty about the long-term contribution of partition areas" examines the impacts of this assumption.

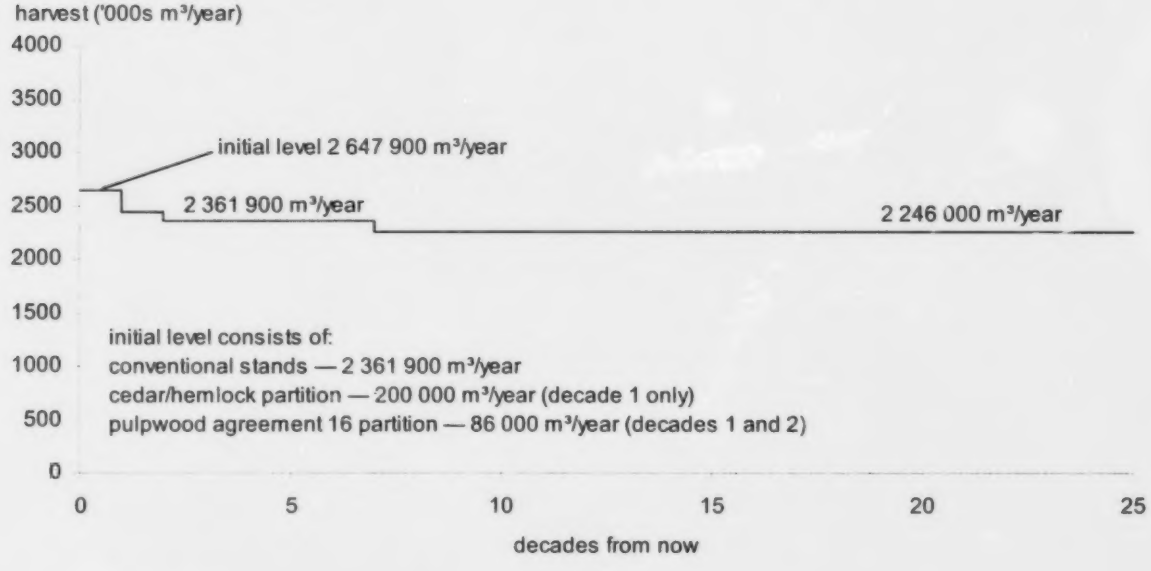

Figure 8. Base case harvest forecast for the Kamloops TSA, 2001.

4 Results

The current allowable annual harvest level attributable to conventionally harvested stands — 2 361 900 cubic metres per year — can be maintained for 70 years before declining by 5% to the long-term harvest level* of 2 246 000 cubic metres per year.

Unsalvaged losses due to natural forces such as insects, wind and fire are estimated to be 62 600 cubic metres per year for the entire 250-year horizon and have been subtracted from all harvest forecasts shown in this report.

Short-term timber supply in the base case harvest forecast for the Kamloops TSA is determined largely by existing amount of timber growing stock*.

Figure 9 shows a projection of timber inventory volumes over time corresponding to the base case harvest forecast. Total growing stock on the timber harvesting land base declines over the next 10 decades from 184 million cubic metres as the oldest of the existing mature stands are harvested and reforested. The average total growing stock over the long term for the base case is 124 million cubic metres. Merchantable growing stock is defined here as that volume of timber which is of harvestable age. The merchantable growing stock begins at about 170 million cubic metres and declines over the long term to about 83 million cubic metres.

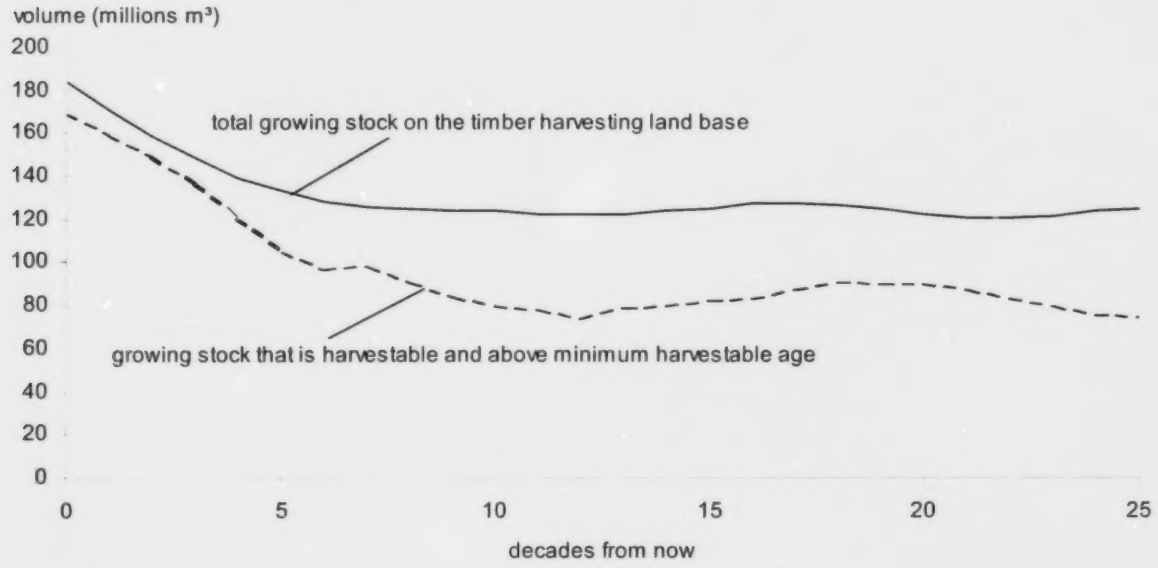

Figure 9. Total and merchantable growing stocks — Kamloops TSA, 2001.

Long-term harvest level
A harvest level that can be maintained indefinitely given a particular forest management regime (which defines the timber ha. vesting land base, and objectives and guidelines for non-timber values) and estimates of timber growth and yield.

Growing stock
The volume estimate for all standing timber at a particular time.

4 Results

The base case long-term harvest level — 2 246 000 cubic metres per year — is the harvest rate that can be achieved while maintaining the total timber growing stock on the timber harvesting land base at an even level, on average, over the long term. An even-growing stock indicates that harvesting can continue at the corresponding harvest level in perpetuity. A continually increasing growing stock would indicate that the timber is being harvested below the productive capability of the land. A continually declining growing stock would signify that the timber is being harvested above the productive capability of the land.

In the medium term, harvesting shifts from existing older stands to managed future stands. Figure 10 shows the contribution to the harvest forecast of existing and managed stands. For the first 6 decades timber supply depends on existing stands, while during decades 8 through 11, it becomes more dependent on managed stands. During the seventh decade, the harvest is approximately evenly split between existing and managed stands, and at that time timber supply approaches the long-term harvest level.

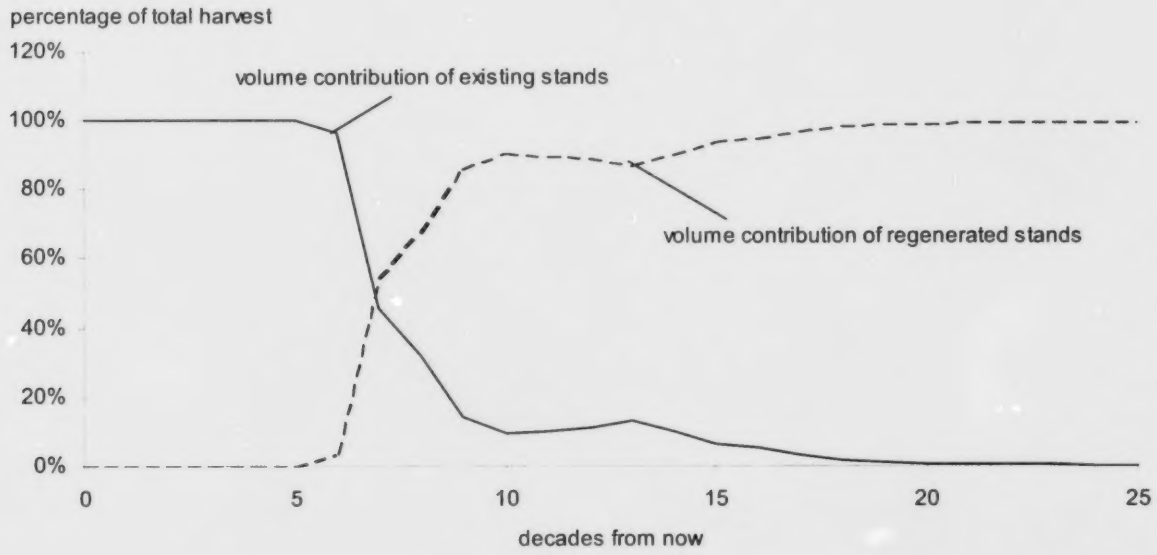

Figure 10. Harvest contribution from the existing and managed stands — Kamloops TSA, 2001.

The average growth rate projected from regenerated stands over the long term is about 2.7 cubic metres per hectare per year. The average productivity was derived by dividing the total timber supply, including unsalvaged losses, by the future timber harvesting land base, not including areas of old cedar and hemlock, and PA 16. If all stands in the long-term timber harvesting land base were projected for harvest at the age of maximum productivity, an annual harvest rate of approximately 2 470 000 cubic metres could be achieved over the long term. However, the long-term harvest level is below this theoretical maximum productive capacity of the timber harvesting land base. The maximum is not achievable since other management considerations, and the objective of maintaining a consistent harvest flow over time. involve retaining stands beyond the time of maximum productivity. The wide range of site productivity, which leads to differences in minimum harvestable age in the TSA adds to the difficulty in scheduling stands for harvest exactly at the age of maximum productivity.

4 Results

4.2 Area, average volume and average age harvested

Figure 11 shows the average annual area harvested over the next 250 years for even-aged harvest systems (areas have not been adjusted to account for unsalvaged losses, although based on the unsalvaged volume and average stand volume, the area corresponding to unsalvaged losses averages between 200 and 300 hectares annually). Average area harvested remains relatively constant through time. A slight reduction occurs over the first three decades to coincide with the expiry of the current partitions and corresponding reduction in the projected harvest. As harvesting begins in second-growth stands, a slight increase in the area harvested is projected, as the volumes per hectare of these stands are typically less than existing forests. The average area harvested over the long term through even-aged management practices is about 7600 hectares per year.

Figure 11. Average area harvested over time — Kamloops TSA base case, 2001.

Not shown on this graph are areas harvested each year with uneven-aged or selection harvest systems. These systems remove only a portion of the trees from each area and are assumed to satisfy many of the forest cover requirements that limit the amount of harvesting on even-aged areas. Therefore, a significant amount of harvest can occur in these stands without violating management requirements, and the harvest can fluctuate dramatically over time, increasing during periods when harvesting in areas of even-aged management is more constrained. During the first eighty years, the average area harvested with uneven-aged systems is approximately 1800 hectares per year. Over the long term the average area harvested is about 4900 hectares per year.

4 Results

Figure 12 tracks the change in the area-weighted harvested age of stands projected for harvest in the base case. Initially the harvest comes from the oldest stands in the timber harvesting land base. During the first 50 years of the forecast, the average harvest age is about 175 years. From decade 10 onward, managed stands comprise more of the forecast harvest, and the average age of the stands harvested declines to an average of approximately 100 years. Areas harvested by selection methods are not included in the average harvested age calculation as these stands are made up of many different ages of trees.

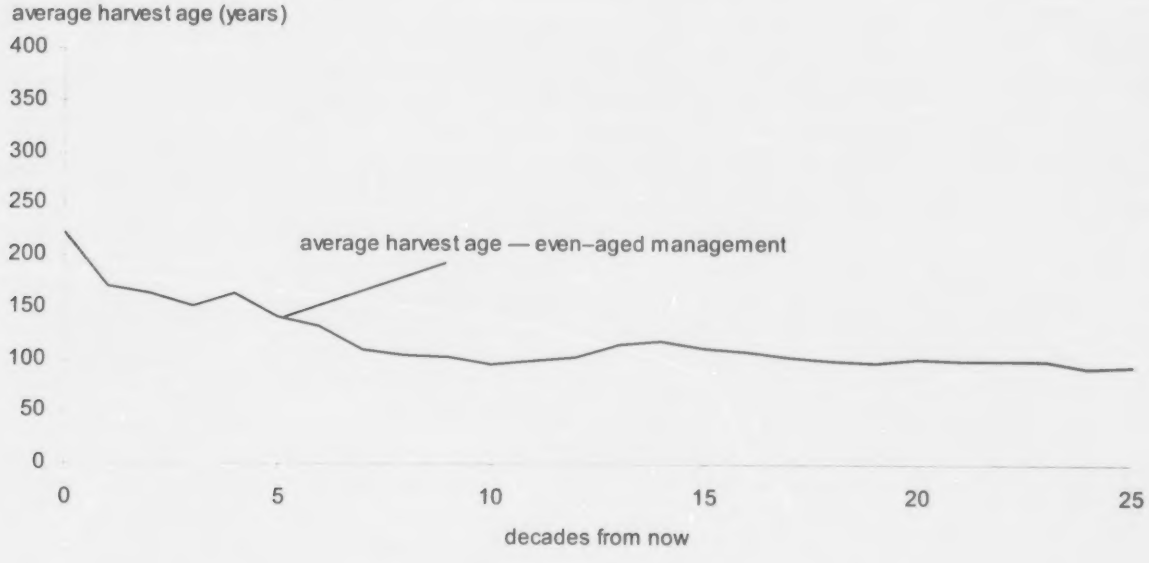

Figure 12. Average age of stands harvested over time — Kamloops TSA base case, 2001.

4 Results

Figure 13 shows the average timber volume harvested during the same period. These average volumes were derived using the total volume projected for harvest in the simulation model; no accounting was made for unsalvaged losses since it was not possible to derive exact figures to account for the area corresponding to the losses. As shown in Figure 13, areas harvested with uneven-aged or selection systems remove a much lower volume per hectare on average. While selection systems remove less volume, harvests occur more frequently. The change in average volume per hectare harvested over time in uneven-aged stands reflects first entry harvests that typically remove more volume than second or third entry harvests. During the first 50 years, average volumes from uneven-aged stands are about 75 cubic metres per hectare. The long-term average is about 35 cubic metres per hectare. Refer to Appendix A (Section A.4.5, "Basic silviculture and regeneration assumptions") for a description of the selection management* regime. The harvested volume for even-aged stands slowly declines during the first fifty years from an average of 325 cubic metres per hectare. The volume per hectare remains fairly constant past fifty years of age, averaging about 280 cubic metres per hectare.

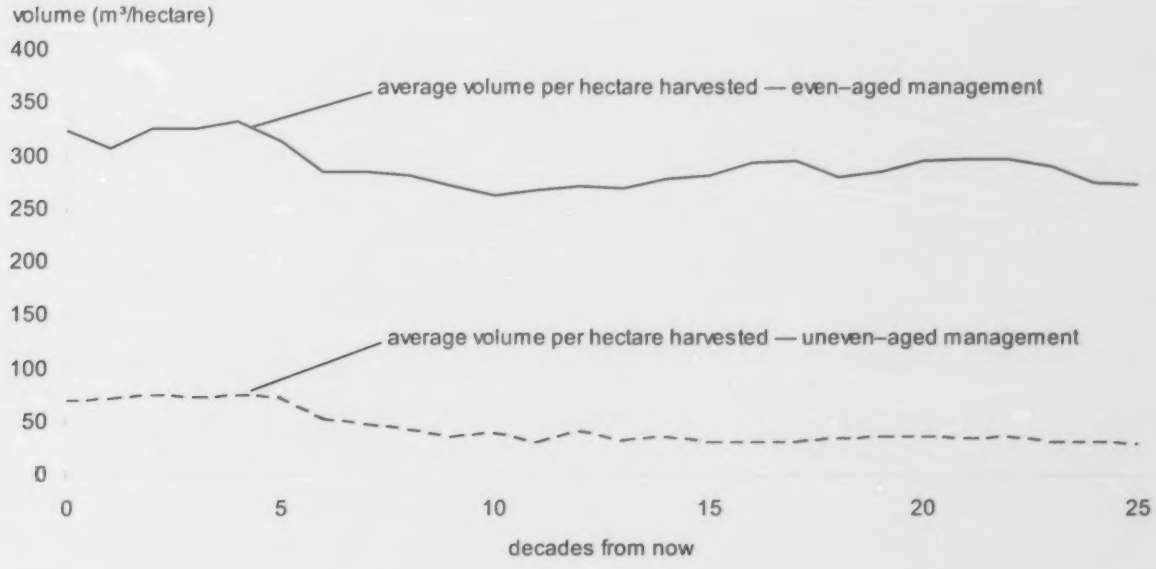

Figure 13. Average volume per hectare harvested over time — Kamloops TSA base case, 2001.

Selection management
A silvicultural system used to maintain or create areas containing a wide range of tree ages or sizes. The time interval between harvests in such areas is fairly short (usually less than 30 years), and during these harvests either single scattered trees or small groups of trees are removed from across the entire area.

4.3 Age class profile over time

The charts in Figure 14 show how the age composition of the Kamloops TSA productive forest land base changes over the next 250 years under the base case harvest forecast. Due to the size of the Kamloops TSA, a simplification of the areas outside of the timber harvesting land base was done to facilitate modelling with FSSIM. All areas with stands older than 250 years of age at the beginning of the analysis were assumed to be 250 years of age. Therefore the following graphs depict the amount of area on the forested non-timber harvesting land base over age 250, but not actual variability in age of these older stands.

The Kamloops TSA contains approximately 1 483 000 hectares of productive forest land, of which 1 040 800 makes up the initial timber harvesting land base. Currently, about 66% of stands within the timber harvesting land base are at or above minimum harvest age. About 7% of the timber harvesting land base is above 250 years of age, 22% is between 140 and 250 years of age, and 19% is below age 40.

Approximately 30% (442 000 hectares) of the productive forest land base is made up of stands outside the timber harvesting land base. In the forest outside of the timber harvesting land base, 42% of the stands are over 140 years old. Almost 9% of the productive forest in the Kamloops TSA is made up of stands greater than 250 years of age, 4% of which are from the non-timber harvesting land base.

The productive forest outside the timber harvesting land base contributes significantly to forest resource objectives, such as those for old-seral* retention for landscape-level biodiversity. Nevertheless, achieving these objectives still requires that some forest within the timber harvesting land base is reserved over time. For example, in 200 years approximately 114 200 hectares (11%) of the timber harvesting land base is projected to be older than 250 years of age. A large portion of this area comprises the partitioned forest types*, since no harvesting is projected to occur in these areas once the current commitments associated with the partitions have expired. For the base case, the forest outside the timber harvesting land base was assumed to age continuously over the analysis horizon. This aging is reflected in the age class distribution in 200 years when, 383 500 hectares (87%) of the non-timber harvesting land base is projected to be covered with forest older than 250 years. Sensitivity analysis examines the impact of uncertainty about this assumption (Section 5.10, "Uncertainty in the application of biodiversity requirements").

Old seral
Old seral refers to forests with appropriate old forest characteristics. Ages vary depending on forest type and biogeoclimatic variant.

Forest type
The classification or label given to a forest stand, usually based on its tree species composition. Pure spruce stands and spruce-balsam mixed stands are two examples.

4 Results

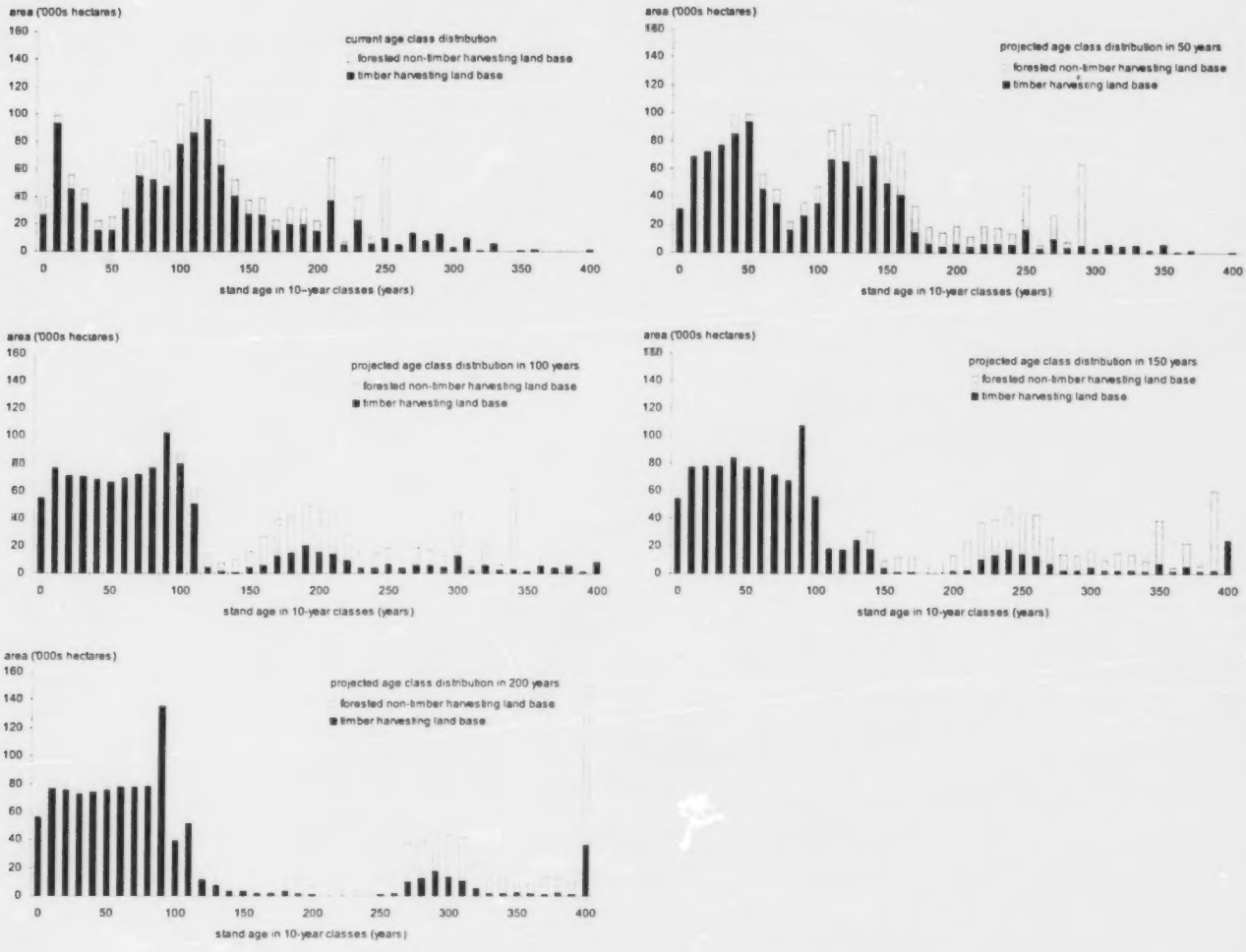
area ('000s hectares)
current age class distribution
forested non-timber harvesting land base
timber harvesting land base
stand age in 10-year classes (years)
area ('000s hectares)
projected age class distribution in 50 years
forested non-timber harvesting land base
timber harvesting land base
stand age in 10-year classes (years)
area ('000s hectares)
projected age class distribution in 100 years
forested non-timber harvesting land base
timber harvesting land base
stand age in 10-year classes (years)
area ('000s hectares)
projected age class distribution in 150 years
forested non-timber harvesting land base
timber harvesting land base
stand age in 10-year classes (years)
area ('000s hectares)
projected age class distribution in 200 years
forested non-timber harvesting land base
timber harvesting land base
stand age in 10-year classes (years)

Figure 14. Changes in age composition on the productive land base over time — Kamloops TSA base case, 2001.

5 Timber Supply Sensitivity Analyses

The best available information on forest inventories and management practices is used to analyse the timber supply implications of continuing with current management. However, forest management is a complicated and ever-changing endeavour that must account for diverse and changing human values, the dynamics of complex ecosystems, and fluctuating and uncertain economic factors. As well, forests grow quite slowly in terms of human time spans, which means that decisions we make today have not only short-term but also long-term effects. In such a context, we cannot be certain that all the data accurately reflect the current state of all values in the forest, how the forest will change, or how our management activities will affect the forest.

One important way to deal with this uncertainty is to revise plans and analyses frequently to ensure they incorporate up-to-date information and knowledge. Frequent planning and decision-making can help minimize any negative effects that may occur if decisions are based on inaccurate information. Frequent revision can also ensure that opportunities that become apparent from new information are not missed.

Another important way of dealing with uncertainty is to assess how values of interest, for example, timber supply, could change if the information used in the analysis is not accurate. Sensitivity analysis is one way of evaluating how uncertainty could affect analysis results, and ultimately decision-making. Sensitivity analysis can highlight that fairly small uncertainties about some variables could have large effects on timber supply projections, or conversely that fairly large inaccuracies in others could have negligible effects. Also, sensitivity analysis could show that some variables affect timber supply more in the short term than in the long term, while others have the opposite effect. Sensitivity analysis can highlight priorities for collecting information for future analyses, and show which variables, and associated uncertainties, have the most significance for decisions. It can clarify whether current best estimates provide safe bases for decisions, or whether high uncertainty about important variables means more conservative decisions may be wiser.

In this section, results of several sensitivity analyses are discussed. The results based on current forest management assumptions (from Section 4) are referred to as the base case.

Unsalvaged losses to natural forces such as insects, fire, and wind are estimated to be 62 600 cubic metres per year for the entire 250-year horizon, and have been subtracted from all harvest forecasts shown in this report.

5 Timber Supply Sensitivity Analyses

5.1 Alternate harvest flows over time

The base case harvest forecast shown in Figure 8 was developed based on several assumptions. For example, the initial harvest level was based on the current allowable annual cut, including the partitions for old cedar/hemlock stands, and Pulpwood Agreement (PA) 16 (subject to its current allotment and the length of time remaining in the agreement). However, several alternative harvest forecasts are possible under current management as represented in the base case.

Figure 15 shows the highest first decade harvest that would be achievable while limiting declines to 10% per decade and without dropping below the base case long-term harvest level. The indicated harvest level of 3 126 000 cubic metres per year is 15% higher than the initial harvest level in base case and the long-term level is reached in decade 4. The starting harvest level is limited by the amount of growing stock that must be reserved until enough second-growth stands become available for harvest.

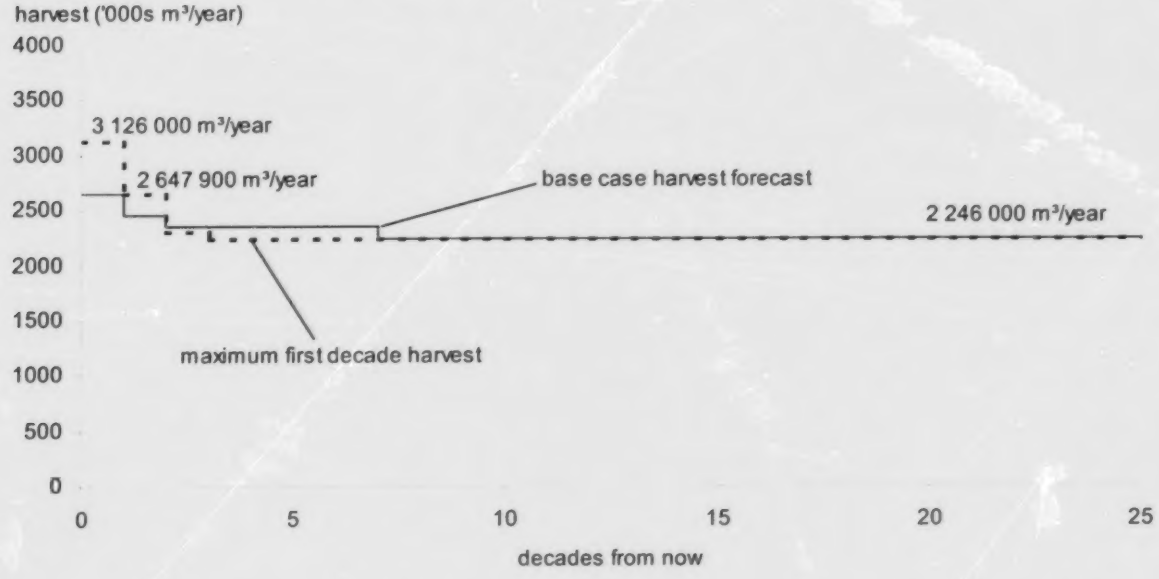

Figure 15. Highest first decade initial harvest — Kamloops TSA, 2001.

5.2 Uncertainty about the long-term contribution of partition areas

As stated under Section 4, "Results," once the agreements related to the cedar/hemlock and PA 16 partitions expire (10 years for cedar/hemlock and 15 years for PA 16) the land base associated with them was no longer available for harvest within the base case (although for simplicity, the land associated with PA 16 was retained for 20 years). Together, the partition areas make up approximately 137 500 hectares, or 13%, of the base case timber harvesting land base, of which an estimated 84 000 hectares contribute to PA 16.

Figure 16 shows the impact of including the areas associated with the partition harvest after expiry of the partitions. Inclusion of these areas allows for maintenance of a non-declining even-flow harvest from decade 3 onwards. This even-flow level is 41 100 cubic metres per year higher in the short-term than the non-partitioned or "regular" harvest level in the base case of 2 361 900 cubic metres per year, and 157 000 cubic metres per year higher in the long term. The land base contributing to the harvest forecast increases by 13% with the long-term contribution of the areas currently under partition. However, the below-average site productivity for the PA 16 sites, plus retention of forest cover in other areas to satisfy forest management objectives only allows the long-term harvest level to be 7% above the base case long term (not shown).

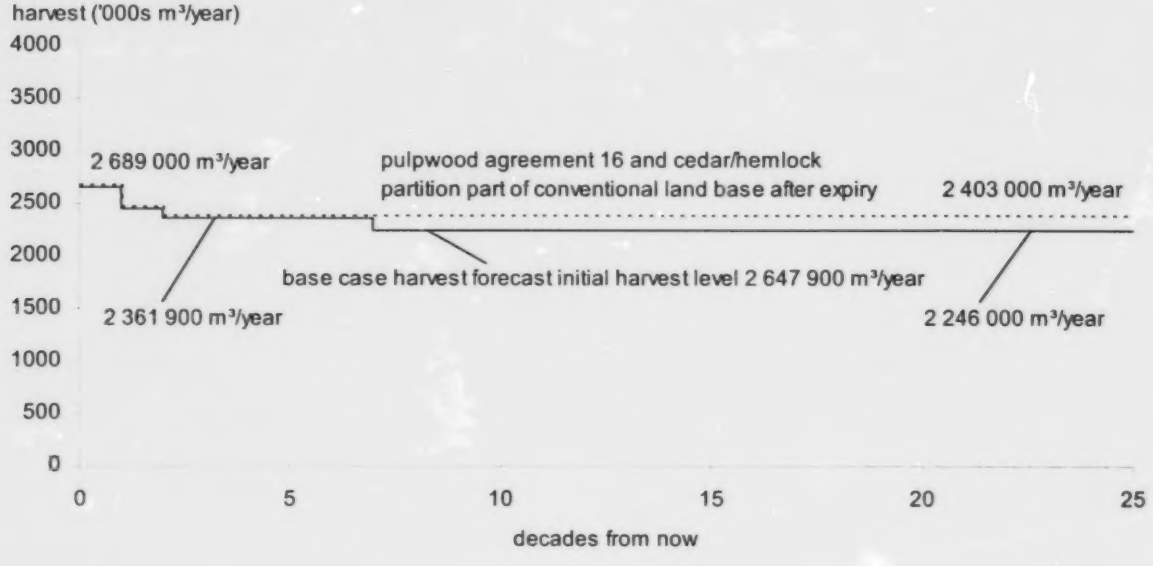

Figure 16. Area of cedar/hemlock and PA 16 partitions included in the non-partitioned harvest land base after expiry — Kamloops TSA, 2001.

5 Timber Supply Sensitivity Analyses

5.3 Uncertainty in the land base available for timber harvesting

Uncertainty in the size of the timber harvesting land base exists because factors such as fluctuations in timber prices, changes in harvesting and milling technologies, and land-use decisions can change the economic feasibility or the social acceptability of harvesting in a particular area.

The timber harvesting land base for the Kamloops TSA has changed significantly since the last timber supply analysis. While several parks were created through the Kamloops LRMP, the timber harvesting land base has increased by approximately 90 000 hectares due to the inclusion of old-hemlock stands and the explicit modelling of Pulpwood Agreement 16.

There is no indication that the timber harvesting land base has been over- or underestimated. However, to assess the effects of land base size on timber supply, two sensitivity analyses were performed. The first evaluated the outcome of decreasing the timber harvesting land base by 10%. The second scenario evaluated a 10% decrease in the non-timber harvesting land base (which corresponds in the Kamloops TSA to a 4% increase in the timber harvesting land base). Table 3 shows the base case and shifted land bases for the sensitivity analyses. Figure 17 shows the resulting harvest forecasts.

Table 3. Area of the base case and land base sensitivity analyses

Forecast	Timber harvesting land base (hectares)	Non-timber harvesting land base (hectares)	Total crown forest (hectares)
Base case	1 040 860	441 684	1 482 544
Reduce timber harvesting land base by 10%	936 774	545 770	1 482 544
Reduce non-timber harvesting land base by 10%	1 085 028	397 516	1 482 544

5 Timber Supply Sensitivity Analyses

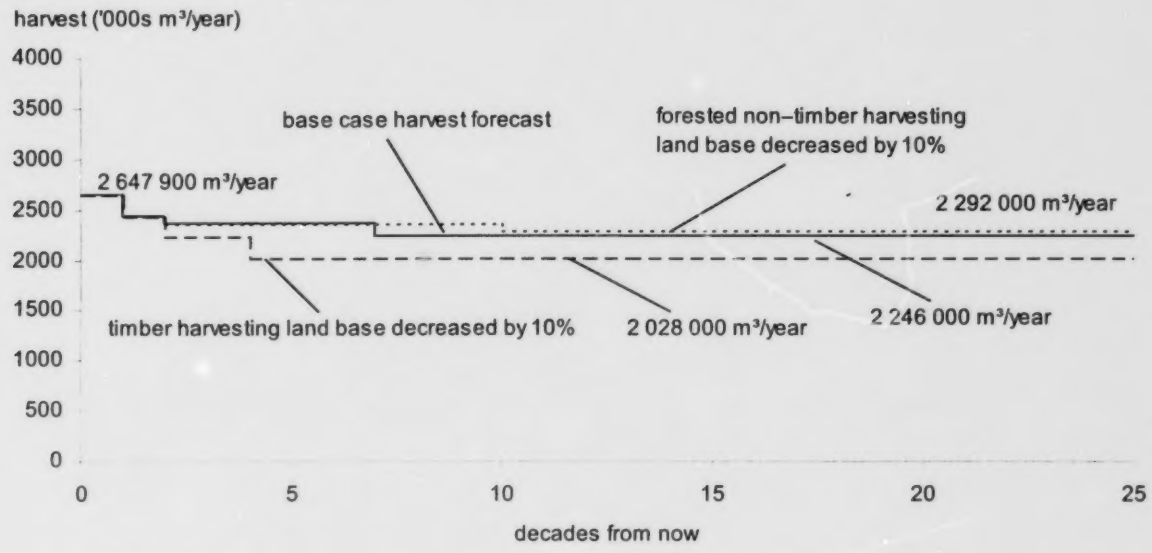

Figure 17. Land base sensitivity analyses — Kamloops TSA, 2001.

Sensitivity analysis shows that if the base case overestimated the timber harvesting land base by 10%, there is still sufficient area in older existing stands to support the initial harvest level for 2 decades. The harvest level then declines by 5%, remaining stable for 2 decades, before declining another 10% to the long-term harvest level of 2 028 000 cubic metres per year. This long-term level is about 10% below the long-term level of the base case. If the non-timber harvesting land base has been overestimated by 10%, the conventional harvest level could be maintained for an additional 3 decades before declining to a long-term harvest level of 2 292 000 cubic metres per year, 2% higher than in the base case. The long-term effect is slightly disproportionate to the increase in the size of the timber harvesting land (4%) because forest outside of the timber harvesting land base contributes to forest cover objectives. Therefore, moving more area into the timber harvesting land base means that forest outside the timber harvesting land base contributes less to those objectives. Also, the area added to the timber harvesting land base is less productive than the average for the timber harvesting land base.

5 Timber Supply Sensitivity Analyses

5.4 Uncertainty in the estimated existing stand yields

Timber volumes estimates for existing unmanaged stands are subject to uncertainties in the forest inventory used to estimate timber volumes (i.e., estimates tree heights and stand ages), and the statistical process used to develop the equations for predicting forest growth and yield. Timber volumes are normally accurate when averaged over large areas, but may not reflect actual volumes within individual stands. Uncertainty may also arise in the estimates of the volume lost to decay in older trees, to waste and breakage during harvest, and to the utilization levels practiced during harvesting.

Over the last several years, the Ministry of Forests, Resources Inventory Branch has performed audits of the standing volume of mature trees (older than 60 years) within TSAs and TFLs across the province. These audits provide an indication of how confident we can be that the estimates of volume are close to the actual volumes in the management unit.

For the Kamloops TSA, audits were done in both the Kamloops and Clearwater Forest Districts. In both districts, ground-measured volumes were, on average, very close to volumes estimated using the inventory.

Nevertheless, sensitivity was done to assess the importance of existing volumes in defining the timber supply forecast for the Kamloops TSA. Figure 18 presents the results of decreasing and increasing existing unmanaged stand yields by 10%. When existing volumes are decreased by 10% across the TSA, a total initial harvest level of 2 404 000 cubic metres per year (9% lower than in the base case) can be achieved. This level comprises a projected harvest of 2 118 000 cubic metres per year from the non-partitioned area (a 10% reduction from the base case level), and maintenance of the two partitions at their base case levels. Timber supply increases to the long-term level in ninety years, once second-growth stands are available to provide most of the harvest.

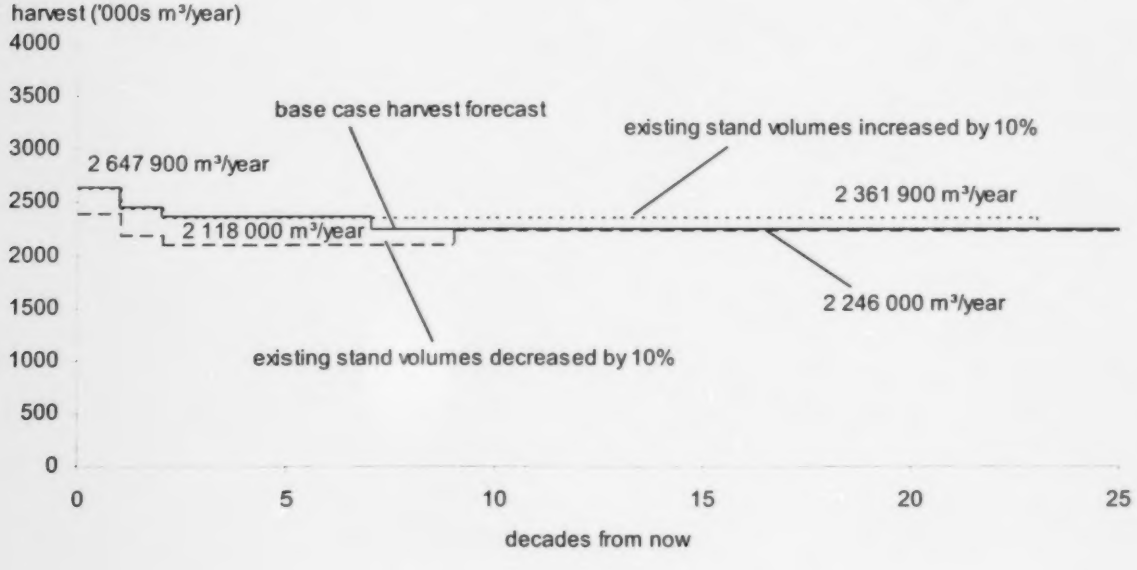

Figure 18. The effect on the harvest forecast of increasing and decreasing volume estimates for existing unmanaged stands by 10% — Kamloops TSA, 2001.

When existing volumes are increased by 10% the non-partitioned harvest level of 2 361 900 cubic metres per year can be maintained for 24 decades before declining to the long-term harvest level.

5.5 Uncertainty in the estimated managed stand yields

Uncertainty in volume estimates for managed stands exists for the same reasons listed for estimated existing stand yields (potential inaccuracies in the forest inventory and the growth and yield models), but also because of the limited experience with, and data available for, regenerated managed stands in B.C. Figure 19 shows the harvest forecasts that result when regenerated managed stand volumes are increased and decreased by 10%. When yields are decreased by 10%, the harvest level decreases by about 10.5% beginning in decade 9, reaching a new long-term harvest level of 2 008 000 cubic metres per year. The long-term effect is slightly disproportionate because unsalvaged losses are subtracted after the harvest forecast is generated.

When regenerated stand yields are increased by 10%, the long-term harvest level can be increased to 2 488 000 cubic metres per year, 10.8% higher than the base case, beginning in decade 10. The initial harvest level for the non-partitioned AAC is not achieved for one decade (decade 8) in this sensitivity analysis. It is important to note that neither increasing nor decreasing regenerated stand yields has any effect on the short-term harvest forecast for the Kamloops TSA. No short-term effect occurs because managed stands are not eligible for harvest until they reach their minimum harvestable ages, some 80 to 120 years from now.

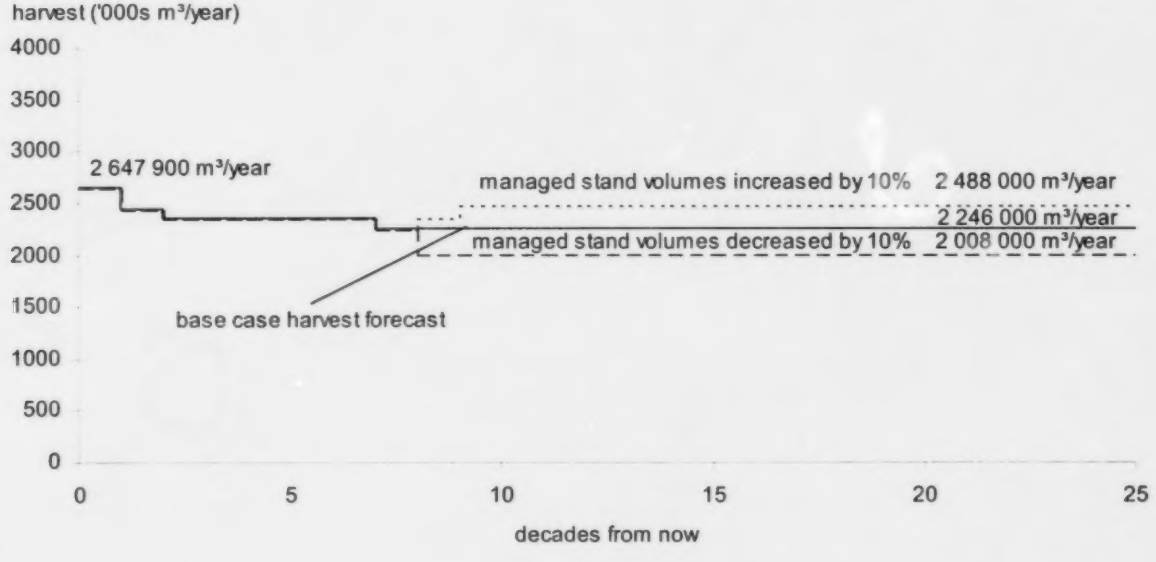

Figure 19. The effect on the harvest forecast of increasing and decreasing volume estimates for managed stands by 10% — Kamloops TSA, 2001.

Since 1993, improved seedlings have been included in reforestation plans in the Kamloops TSA. Between the years 1993 and 2000, an average of 15.7 million seedlings per year have been requested for the Kamloops TSA. Of this amount, about 3.8 million or 24% have been from improved stock. Therefore, trees from improved seed may contribute in excess of 25% of the annual harvest in the future (assuming clearcutting or similar system and average site productivity). It is expected that as more lodgepole pine seed becomes available, this percentage will increase given the large areas of this species currently within the TSA.

The genetic worth of the improved stock has also been increasing between 1993 and 2000. At present trends of improved seedling production, the gain is expected to average 10% in 10 years. A 10% genetic worth, applied to 25% of the harvest land base, would provide about a 2.5% gain in expected long-term yield. The above evaluation was based on information that includes the two TFLs within the TSA boundaries; however, the TFLs are relatively small compared to the TSA, and their inclusion does not substantially alter the reported trends.

This gain was not factored into the base case, but the potential impacts can be approximated using the sensitivity analyses in Figure 19 (that is, long-term impacts are approximately proportional to the change in managed stand yields).

5.6 Uncertainty in the estimates of management zone objectives for visual quality

In the Kamloops TSA, areas determined to be visually sensitive to timber harvesting occupy about 39% of the timber harvesting land base. These areas usually have fewer trees removed during harvesting to maintain the desired level of visual quality. The acceptable level of harvest from visually sensitive areas is a function of the visual absorption capacity, the visual quality rating, and the current visual condition for each area. Uncertainty about forest cover and green-up objectives for visual quality may arise from inventory and classification of land into visual absorption capacity classes, from estimates of how well different disturbance limits may meet visual objectives, and from estimates of how non-harvestable forest contributes to visual quality.

Existing guidelines for visual management provide a range of forest cover requirements that may apply to a visual management area. The specific cover requirement that is applicable to an area depends on visual absorption capacity and degree of visual design of harvesting units. In the base case, the mid-point of the range of potential requirements was used. Figure 20 shows the effect of setting the forest cover requirements for visual management areas both at the minimum or lower end of the range, which increases the requirements, and at the maximum or upper end of the allowable range, effectively relaxing the requirements.

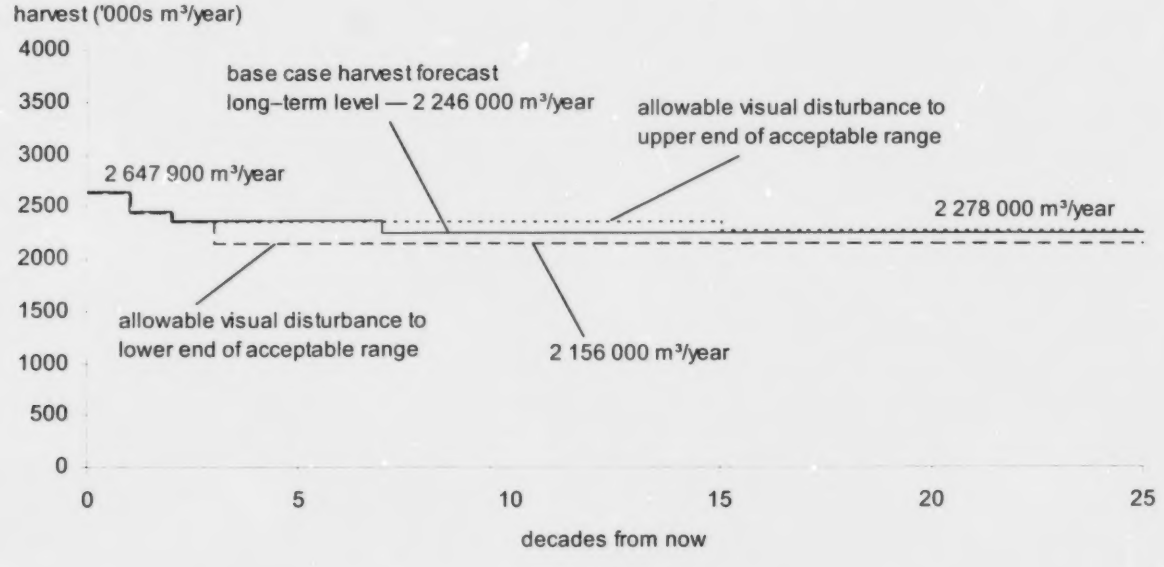

Figure 20. The effect on the harvest forecast of increasing and decreasing forest cover requirements for visually sensitive areas to the upper and lower end of the acceptable range — Kamloops TSA, 2001.

Relaxing forest cover requirements for harvesting-related visual disturbance to the upper end of the acceptable range in each visual area allows the non-partitioned harvest level to be maintained for 15 decades. The long-term harvest level increases by about 30 000 cubic metres per year (1.3%) above the base case. If forest cover requirements were decreased to the lower end of the acceptable range, the non-partitioned harvest level could only be maintained for 3 decades before declining by 9% to a long-term harvest level 4% below the base case.

5 Timber Supply Sensitivity Analyses

Within visually sensitive areas the length of time required between harvesting of one area and subsequent harvesting on adjacent cutblocks varies depending on the mix of species and sites in the area. The green-up period is a function of the length of time it takes regenerating trees to become a certain height. Within the Kamloops TSA visual green-up is achieved between 16 and 21 years. Uncertainty around estimates of site index, or different silvicultural treatments* may result in achievement of the appropriate green-up height either earlier or later than assumed. Figure 21 shows that increasing the time to reach green-up by five years causes a small reduction in the long-term harvest level of about 30 000 cubic metres per year. As well, the base case forecast can only be maintained for forty years. If visual green-up were achieved five years sooner than estimated in the base case, the existing non-partitioned timber supply level could be extended to the twelfth decade, and there would be a small (1.3%) increase in the long-term harvest level to 2 276 000 cubic metres per year.

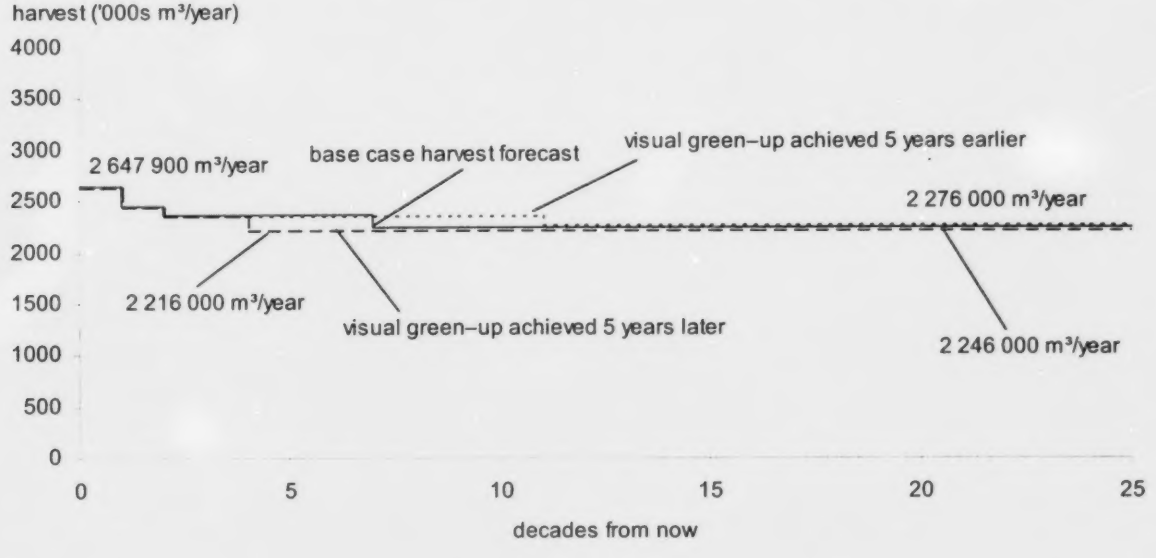

Figure 21. The effect on the harvest forecast of increasing and decreasing green-up requirements for visually sensitive areas by 5 years — Kamloops TSA, 2001.

Silvicultural treatments
Activities that ensure the regeneration of young forests on harvested areas, enhance tree growth or improve wood quality in selected stands. Activities include: site rehabilitation and preparation, planting, spacing, fertilization and pruning.

5 Timber Supply Sensitivity Analyses

5.7 Uncertainty in the estimate of minimum harvestable ages

Minimum harvestable age is an estimate of the time needed for a stand to reach merchantable condition. The time at which stands will become merchantable is not known exactly because of uncertainty about the growth of regenerated stands, and an inability to foresee future conditions that will determine merchantability. Within the Kamloops TSA, about 66% of the existing forest is above the applicable minimum harvestable ages. Therefore, in this unit, changes in the minimum harvestable age definition primarily affect when second-growth stands become available for harvest, dictating the length of time over which the existing harvestable forest will make-up the bulk of the timber supply forecast. Figure 10 in Section 4 shows that existing stands are projected to comprise almost all of the harvest forecast for the next 60 years.

For this analysis, minimum harvestable ages for existing stands were estimated to be between 80 (pine and wet-belt fir) and 140 years (old cedar and hemlock partition) and are detailed by leading species in Appendix A (Section A.4.3, "Minimum harvestable age derivation"). Managed stands have different minimum harvestable ages, which were determined based on achieving approximately 90% of the culmination of mean annual increment (CMAI)*, and are also detailed in Appendix A. The minimum harvest ages for managed stands range from 80 years on good and medium sites to 130 years on poorer sites. The minimum harvestable ages are not necessarily the actual age of harvest; stands may be harvested at older but not younger ages. Most stands are harvested at ages beyond the minimum in order to meet management requirements for other forest values. Minimum harvestable ages are meant to approximate the timing of merchantability, and are not legal or policy requirements.

Mean annual increment (MAI)
Stand volume divided by stand age. The age at which average stand growth, or MAI, reaches its maximum is called the culmination age (CMAI). Harvesting all stands at this age results in a maximum average harvest over the long term.

5 Timber Supply Sensitivity Analyses

Figure 22 illustrates the impact of increasing or decreasing minimum harvestable ages by 10 years. When ages are increased by 10 years, the amount of time before second-growth stands become available is lengthened. The base case forecast can only be held for fifty years before declining by 9%. The forecast rises to the long-term harvest level in decade 14. When minimum harvestable ages are decreased by 10 years, the non-partitioned harvest can be extended until decade 17, before declining to the same long-term harvest level as the base case.

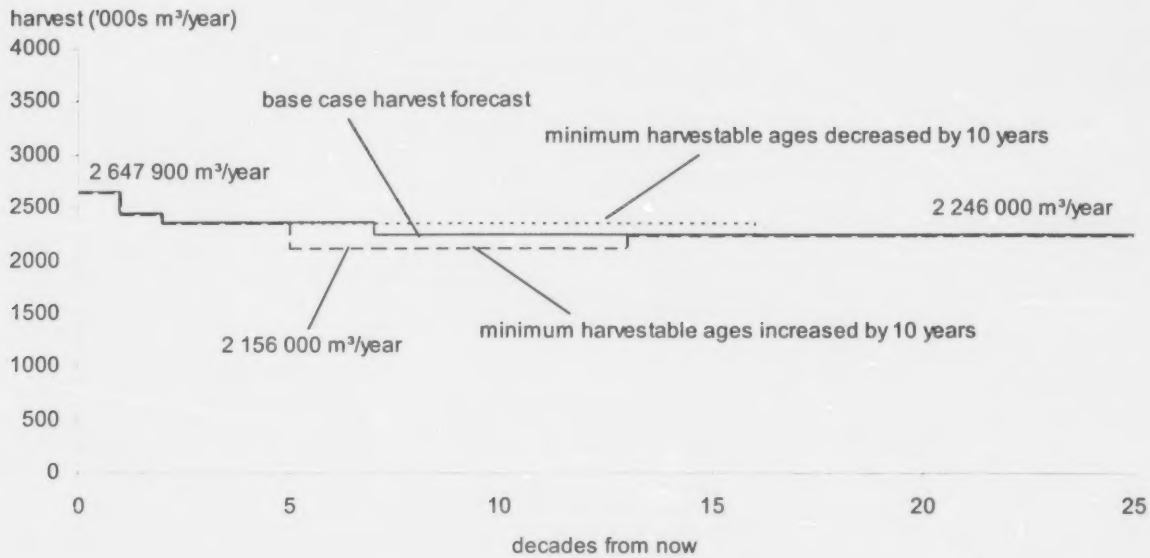

Figure 22. Harvest forecasts if minimum harvestable ages are increased or decreased by 10 years — Kamloops TSA, 2001.

5.8 Uncertainty in adjacency and forest cover requirements

Adjacency and forest cover requirements for each of the management zones in this analysis are described in Appendix A, Section A.4.8, "Forest cover requirements — resource management zones." In some zones, the height that regenerated forest must reach before an adjacent site may be harvested, and the proportion of the area that may be below that height are prescribed. Requirements for visually sensitive areas were evaluated in Section 5.6, as these areas occupy a significant portion of the timber harvesting land base. This section focuses solely on the requirements for standard management, the baseline for management within the TSA, since other management zones do not involve as significant a land base.

Green-up age — the age at which a stand exhibits the required height (3 metres for standard management) — was determined using an area-weighted average of the time estimated to reach 3 metres, based on species, silvicultural regime and site productivity with each analysis unit (AU)*. There is uncertainty about green-up age since variations in local stand growth from the average may result in stands reaching the desired condition sooner or later than estimated.

Analysis unit
A grouping of types of forest — for example, by species, site productivity, silvicultural treatment, age, and or location — done to simplify analysis and generation of timber yield tables.

5 Timber Supply Sensitivity Analyses

Figure 23 shows the result of varying the length of time taken to reach a 3 metre green-up by 5 years. The average amount of time to reach 3 metres in the base case was estimated as 16 years. The results of both sensitivity analyses show little impact on the base case harvest forecast. However, unexpectedly, increasing the length of time to green-up by 5 years (an average of 21 years across the TSA) allowed the non-partitioned AAC level to be held for an additional decade when compared to the base case. This is due to an altering in the harvest queue allowing some stands with lower minimum harvestable ages to be accessed sooner than the base case. In general, the results suggest that medium-term timber supply has a small amount of sensitivity to changes in green-up period in the standard management areas, but that the forecast may be just as sensitive to changes in harvest scheduling.

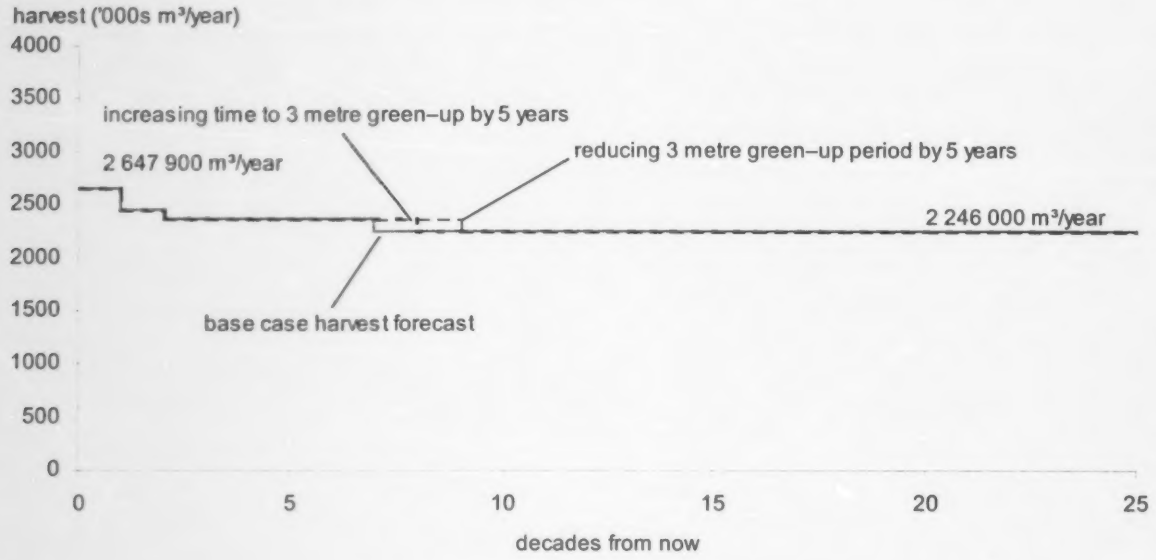

Figure 23. Harvest forecasts if 3 metre green-up achieved 5 years sooner or 5 years later — Kamloops TSA, 2001.

5 Timber Supply Sensitivity Analyses

In conjunction with requirements for green-up height, there are also limits on the amount of area that may be below the green-up height, the size of harvest blocks and the conditions that must be achieved before additional harvest may occur in an area. As an approximation of these objectives for the standard management zone, no more than 33% of the harvestable area was allowed to be below the green-up height. Objectives for other management zones, and the areas to which they apply, are detailed in Appendix A. The value of 33% is based on an estimate that three entries would be required to harvest all of the timber harvesting land base within a landscape unit, biogeoclimatic zone variant, while maintaining an acceptable degree of forest cover.

The extent to which the 33% maximum limit represents the actual constraint of all relevant restrictions on harvesting is uncertain. Figure 24 shows the effects of limiting the proportion of the timber harvesting land base below green-up age to 25% and 20%. If the area below green-up is limited to 25% the non-partitioned AAC harvest level can be maintained for an additional decade compared to the base case. As with the analysis of green-up age above, this effect is an artifact of a change in order in which stands are accessed rather than a real effect of the forest cover requirement. The different harvest queue allows some of these stands to be harvested as second growth sooner than in the base case. The result indicates that timber supply is not sensitive to a change in the green-up limitation from 33% to 25%.

When no more than 20% of the harvestable land base is allowed below green-up, the base case harvest forecast can be achieved for only forty years. The long-term harvest level, however, is slightly higher than the base case due to stands being harvested closer to their maximum mean annual increment (MAI) age.

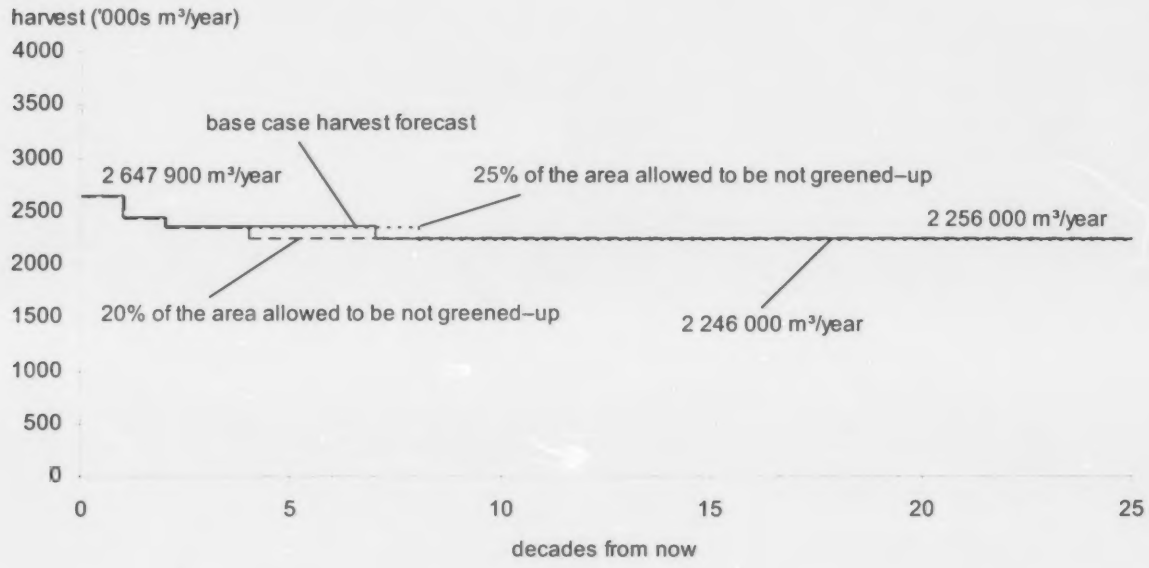

Figure 24. Harvest forecasts if the maximum percentage of the timber harvesting land base below green-up is decreased to 25% and 20% — Kamloops TSA, 2001.

5 Timber Supply Sensitivity Analyses

5.9 Uncertainty in the productivity of current old-growth sites after harvest

Estimating the future productivity of sites currently occupied by old-growth forest is difficult since it is not possible to know with certainty how the productivity of a regenerated stand will compare to the productivity indicated by the existing stand it replaces. The productivity of a site largely determines how quickly trees will grow. It therefore affects the timber volumes in regenerated stands, the time to reach green-up and the age at which those stands will reach merchantable size. The most accurate estimates of site productivity come from stands between about 30 and 150 years old. At ages less than about 30 years, a temporary increase or decrease in growth due to factors such as a post-harvest flush of nutrients or an unusual drought year can affect the overall productivity estimated for the stand. At older ages, site productivity estimates may be incorrect because tree heights do not represent actual production — for example due to top breakage — and it can be difficult to determine ages of old trees accurately, for example, due to decay.

The results of recent province-wide research suggest that the estimated productivity of sites currently occupied by old-growth stands may be significantly underestimated. Two Old Growth Site Index (OGSI) studies applicable to timber supply forecasting are:

- *Site index adjustments for old-growth stands based on paired plots* (Nussbaum 1998). Data were obtained from paired plots installed in old-growth stands and adjacent logged and regenerated stands of the same productivity. Site index was estimated for both and comparisons were made. Results are available for Douglas-fir, lodgepole pine, and interior spruce.
- *Site index adjustments for old-growth stands based on veteran trees* (Nigh 1998). The objective of the study was to develop site index adjustments for species not covered by the paired-plot project. The data for this study came from temporary and permanent plots with a veteran and main stand component. The site indices for the two components were estimated and an adjustment equation for each species was derived using linear regression analysis. The results of the study are considered less reliable than those from the paired-plot study.

The results of the aforementioned studies are of particular interest to the Kamloops TSA, since stands older than 140 years comprise approximately 29% of the timber harvesting land base. To test the sensitivity of the base case harvest forecast to uncertainty about site index estimates, a sensitivity analysis was performed. Site indices of these older stands were adjusted using either the paired plot or veteran-tree results, whichever was applicable. Managed stand volume estimates for those analysis units affected by changes in estimated future productivity were recalculated based on average adjusted site productivity. The minimum harvestable ages for these units were also recalculated. Table 4 compares the average forest inventory-based site index for each analysis unit with old growth to those recalculated using the OGSI adjustments.

5 Timber Supply Sensitivity Analyses

Table 4. Average analysis unit site index based on forest inventory and OGSI information — Kamloops TSA, 2001

Analysis unit	Timber harvesting land base area (hectares)	Inventory site index	Adjusted site index
Dry fir, small patch	13 205	15.54	16.53
Wet fir, good/medium	24 673	17.18	18.79
Wet fir, poor	9 884	13.56	16.48
Balsam, good/medium	5 886	14.16	16.69
Balsam, poor	28 992	10.67	14.68
Spruce, good/medium	24 369	16.90	20.52
Spruce, poor	65 725	11.03	18.92
Pine, good/medium	13 827	16.37	20.02
Pine, poor	10 004	12.60	18.54
Dry fir, small patch, PA 16	879	11.51	12.60
Wet fir, PA 16	3 086	12.64	12.80
Balsam, PA 16	2 603	11.29	11.58
Spruce, PA 16	829	11.82	12.38
Pine, PA 16	32 570	12.13	12.68
Cedar, good/medium	3 676	18.38	20.44
Cedar, poor	26 698	14.51	19.82
Hemlock, good/medium	1 121	17.21	19.96
Hemlock, poor	21 741	12.95	18.18

5 Timber Supply Sensitivity Analyses

Figure 25 presents the results of the OGSI sensitivity analysis. Application of OGSI adjustments increases the average site index for the Kamloops TSA from 15.5 to 16.6. For only those stands greater than 140 years of age, the change in average site index is from 13.3 to 17.3, a 30% increase. When the OGSI adjustments are applied, the effect on the harvest forecast is significant throughout the entire time frame. The harvest forecast for the non-partitioned areas can be maintained at 2 492 000 cubic metres per year over the 250-year analysis horizon, representing an 11% increase in the long-term harvest level. The short-term harvest can also be increased, by 5.5%, due to the additional flexibility provided by the increase in second-growth volume combined with a reduction in minimum harvest ages. Since the partitioned harvests are projected at the existing levels over the first 20 years, this short-term increase applies to the non-partitioned area.

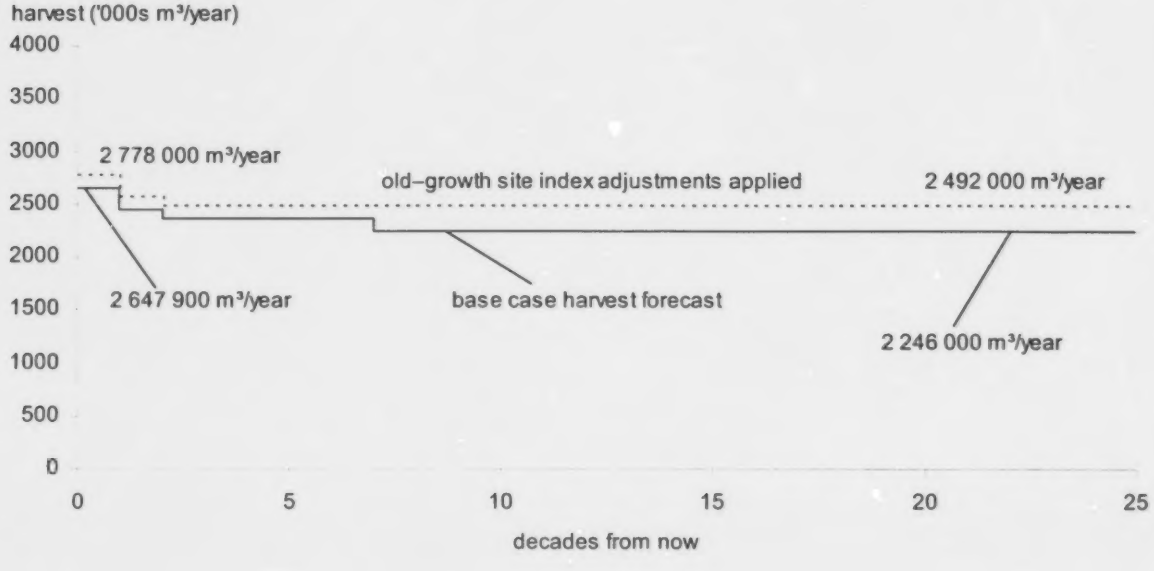

Figure 25. Harvest forecast based on OGSI (paired plot and veteran studies) site index adjustments — Kamloops TSA, 2001.

5 Timber Supply Sensitivity Analyses

5.10 Uncertainty in the application of biodiversity requirements

The *Forest Practices Code of British Columbia Act* describes the conservation of biological diversity as an essential consideration in the sustainable use of forests. Within the Kamloops TSA, the Higher Level Plan portions of the Kamloops LRMP that deal with biodiversity reference the *Biodiversity Guidebook* as the guide to biodiversity management, while limiting the impact of biodiversity on short- and long-term timber supply within the plan area to 4%.

Stand-level biodiversity was addressed in this analysis through volume reductions for each stand on the timber harvesting land base. Therefore, the potential effects of uncertainty about stand-level biodiversity can be assessed through the sensitivity analyses that examine uncertainty in timber yields.

Management for landscape-level biodiversity was represented in this analysis with forest cover constraints that apply to landscape unit — biogeoclimatic zone/variant combinations. The level of retention for old forests within each combination was determined by applying the *Biodiversity Guidebook* recommendation applicable to the biodiversity emphasis option for each landscape unit, as provided by the Kamloops LRMP. At this time, there is a requirement in the Kamloops LRMP area to achieve full old-seral retention levels within low BEO landscape units as soon as possible. The remainder of this section describes results of sensitivity analysis performed to assess the potential timber supply effects of uncertainty about biodiversity requirements.

5 Timber Supply Sensitivity Analyses

Figure 26 shows the effect of removing biodiversity requirements for old-sera! forests and wildlife tree patches. The base case short-term harvest levels are achievable, and the non-partitioned harvest level of 2 361 000 cubic metres per year can be maintained for 200 years, compared to 70 years in the base case, before a slight decline of 2.5%. The long-term harvest level is 2.5% above the base case level. As noted for the base case in Section 4.3, "Age class profile over time," 200 years into the harvest forecast, approximately 114 000 hectares of timber harvesting land base are projected to be greater than 250 years of age. When the old-seral requirements are removed, approximately 112 000 hectares of timber harvesting land base above age 250 still remain 200 years into the harvest forecast. While it would be expected that removal of the requirements would release a significant amount of older forests for harvesting, this result suggests that over the long-term forest in parks and protected areas, areas retained and managed for non-timber values such as wildlife habitat or visual quality, and areas outside the timber harvesting land base can meet overall old-seral requirements without applying further requirements to the timber harvesting land base.

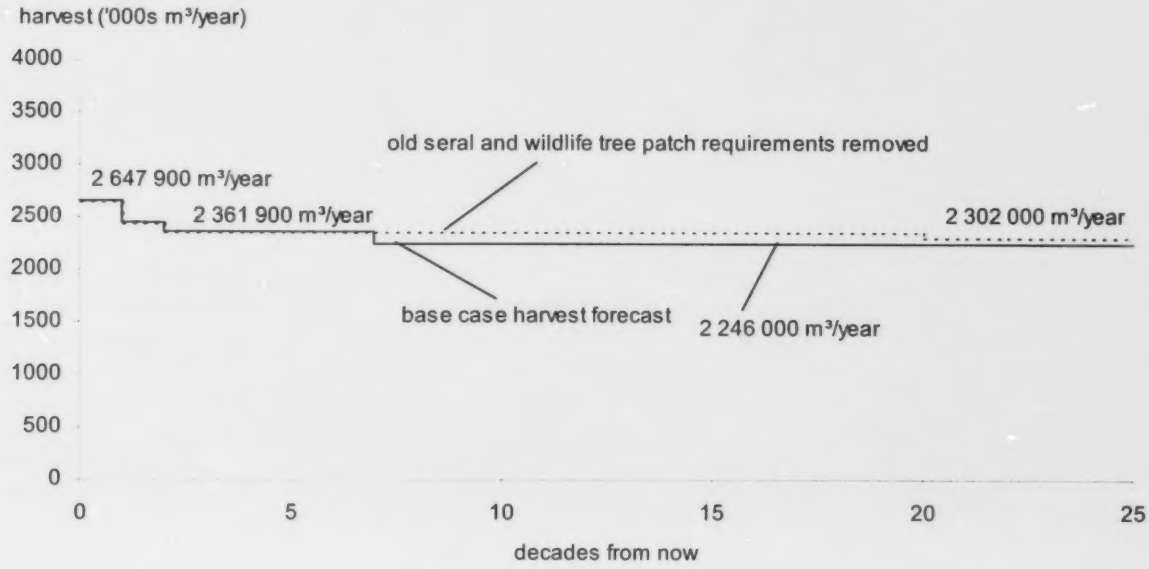

Figure 26. Harvest forecast with old seral and wildlife tree patch requirements removed — Kamloops TSA, 2001.

5 Timber Supply Sensitivity Analyses

The *Forest Practices Code Landscape Unit Planning Guide (LUPG)* allows for phasing in of the old-seral requirements in low BEO areas. Phase-in (or draw down) consists of initially reducing the requirement to one-third of the full amount in anticipation of achieving the full target by the end of the third rotation. Figure 27 shows the effect of immediately drawing down to one-third of the old-seral target in low BEO landscape units. The non-partitioned harvest level can be maintained for an additional two decades, and the long-term harvest level is slightly higher than the base case.

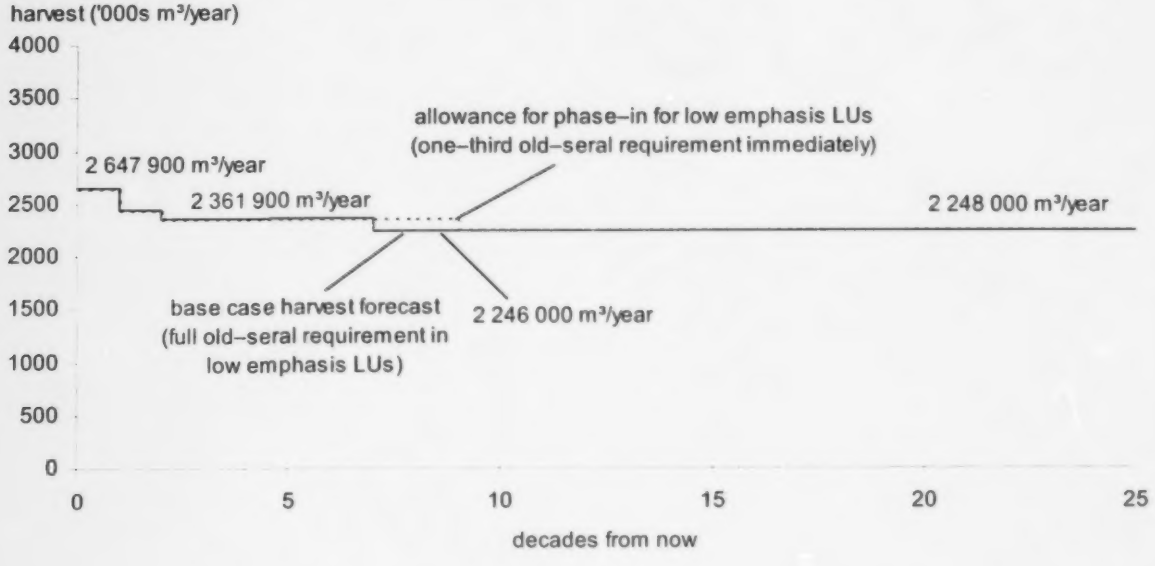

Figure 27. Harvest forecast with one-third immediate draw down in low BEO landscape units — Kamloops TSA, 2001.

5 Timber Supply Sensitivity Analyses

While the *Biodiversity Guidebook* references targets for early and mature, as well as old seral, at this time only old-seral requirements are being applied within the Kamloops TSA. Figure 28 shows the effect of applying early- and mature-seral* targets in addition to those for old forest. As shown in Figure 28, while the mature- plus -old requirements have a medium-term impact (early-seral requirements had no incremental effect), there is no long-term harvest level impact relative to the base case. The lack of long-term effect reflects the assumption that forests outside the timber harvesting land base will continue to age over time to eventually be over 250 years old.

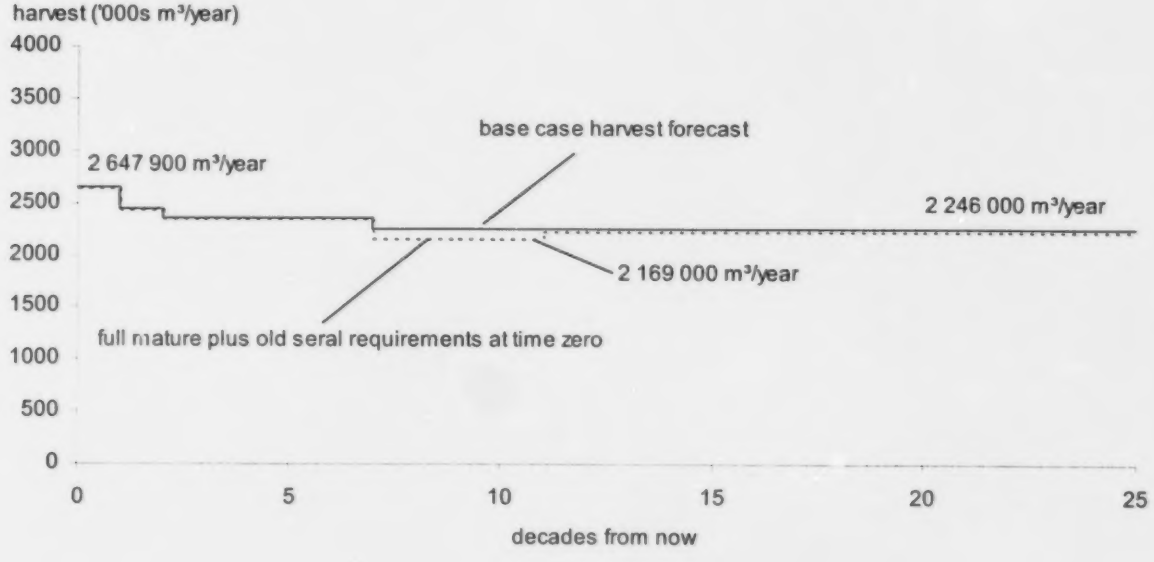

Figure 28. Harvest forecast with mature- plus -old as well as early-seral targets — Kamloops TSA, 2001.

An alternative approach to allowing the non-timber harvesting land base forests to continue to age, would be to assume that the existing age class composition in non-contributing stands remains the same as the current distribution (i.e., that disturbances will offset the aging of the forest). Figure 29 shows the impact of the "static" or non-aging approach. The length of time the initial base case forecast can be maintained is reduced by two decades, followed by reduction to a long-term harvest level 3.5% lower than the base case. After 200 years, about 147 000 hectares of timber harvesting land base is projected to contain forest greater than 250 years of age under the non-aging approach, between 3 and 4% more than in the base case.

Mature seral
Forest stands with trees between 80 and 120 years old, depending on species, site conditions and biogeoclimatic zone.

The "static" approach however, assumes a level of natural disturbance that may be unlikely since fire suppression will probably enable a higher proportion of non-contributing forest to age undisturbed over time than in the past. Assuming no aging of currently young stands outside the timber harvesting land base may underestimate their increased future contribution to old-seral requirements. Figure 29 shows projected harvested levels when the old-seral age is lowered to age 200 (reduced 50 years) for NDTs 1, 2, and 4 or to age 100 for NDT 3 (reduced 40 years), and the static approach is taken. The effects of these changes are intermediate between the impact of the static approach using base case old-seral ages, and the aging approach used in the base case.

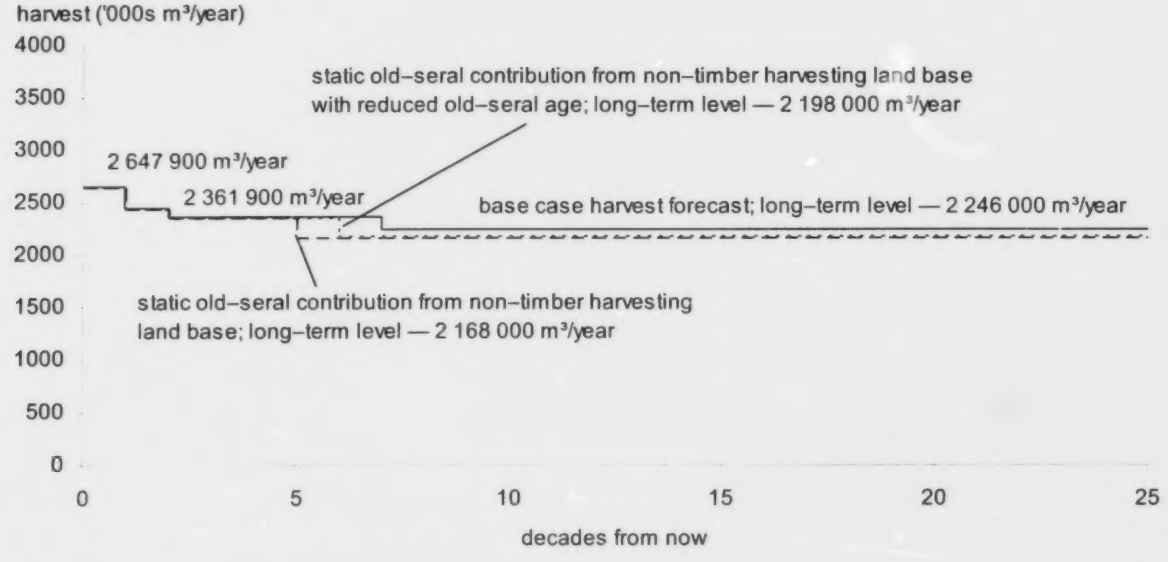

Figure 29. Harvest forecast if alternative approach is taken for aging of forest stands in areas outside of the timber harvesting land base — Kamloops TSA, 2001.

In summary, the assumption that forest outside the timber harvesting land base will continue to age indefinitely probably overestimates its contribution to old-forest values. However, the assumption that the overall age composition of the non-timber harvesting forest will remain the same through time probably underestimates its contribution to old-seral requirements. The timber supply forecast is not highly sensitive to this uncertainty. Timber supply decreases by a small amount in the medium- and long-terms.

5 Timber Supply Sensitivity Analyses

5.11 Alternative harvest priority rules

In the base case, the highest priority for harvest is given to stands that are the oldest relative to their minimum harvestable age. This 'relative oldest first' rule is applied only after other requirements and priorities (e.g., forest cover requirements) are taken into account. This harvest queuing rule reflects the practice of favouring older stands, but not necessarily the oldest, for harvest when all other considerations have been met. In addition to the relative oldest first rule, the Forest Service Simulator model (FSSIM) permits the use of absolute oldest first, absolute youngest first, or random scheduling rules. These other rules may better reflect management practices under certain conditions that affect which stands are chosen to be harvested first. Figure 30 shows the impact of two alternative harvest rules.

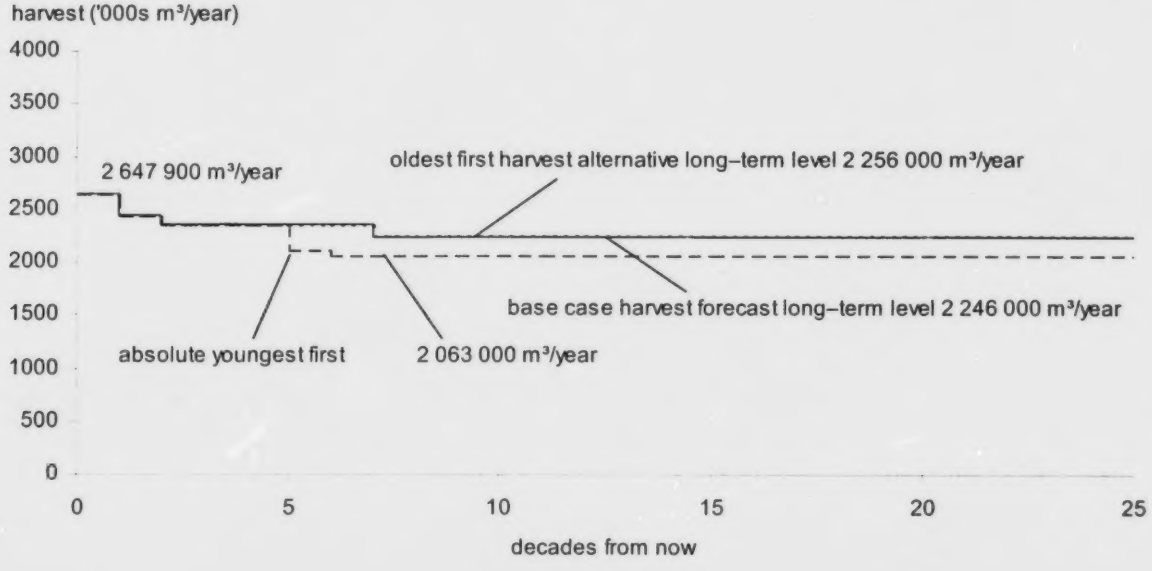

Figure 30. Alternative harvest queue (priority) rules — Kamloops TSA, 2001.

The 'absolute oldest first' harvest rule gives priority in the harvest queue to the oldest stands. Other than a very small increase (0.4%) in the long-term harvest level, this harvest rule resulted in an outcome similar to the base case. The 'absolute youngest first' harvest rule sets the highest priority on stands that have just reached the minimum harvestable age. Under this rule, the base case could be achieved for fifty years before timber supply declined to a long-term harvest level 8% below the base case.

The impact of using a random harvest rule, whereby all stands above minimum harvestable age are equally likely to be chosen for harvest, is not shown. The harvest forecast for a random rule would be between the forecasts with the absolute oldest and youngest first rules since a random rule would result in harvesting of stands between the ages that would be given priority with the other two rules.

6 Summary and Conclusions of the Timber Supply Analysis

The results of this timber supply analysis indicate that non-partitioned or regular portion of the Kamloops TSA allowable annual cut, 2 361 900 cubic metres per year, could be maintained for seventy years before declining by 5% to a long-term harvest level of 2 246 000 cubic metres per year. Additionally, the analysis indicated that the partitioned harvests for old cedar and hemlock stands (200 000 cubic metres per year) as well as Pulpwood Agreement 16 (86 000 cubic metres per year) could be maintained for the remainder of their current obligations. The base case harvest forecast shows the first ten years harvest to be 2 647 900 cubic metres per year, accounting for the additional 286 000 cubic metres of partition harvest. The second decade harvest for the base case is 2 447 900, accounting for the remainder of the existing term of Pulpwood Agreement 16 and the non-partitioned allowable harvest.

The base case results reflect current knowledge and information on forest inventory, growth and yield, and management. However, uncertainties about several factors important in defining timber supply could affect the harvest flow.

Short-term timber supply (defined as the next 20 years) is sensitive to changes that influence the amount of timber available from existing unmanaged stands because the projected harvest relies on these stands almost entirely for the next 60 years, and to a lesser degree over the subsequent 30 years. In particular, any reductions in estimates of timber volumes from existing stands could have immediate negative impacts on short-term harvest flow.

Medium-term (21 to 80 years from now) timber supply is affected by uncertainties in visual management requirements, the size of the timber harvesting land base, minimum harvest ages, green-up and forest cover requirements, and the rule used to set priorities for harvest scheduling, in addition to the factors that affect short-term supply.

Long-term timber supply (beyond 80 years from now) is affected by uncertainties in the estimates of regenerated stand yields, estimates of site productivity for old-growth stands, the availability of improved seeds from seed orchards, visual management requirements, the size of the timber harvesting land base, the rule used to set priorities for harvest scheduling, and to a lesser extent the contribution of forest outside the timber harvesting land base to biodiversity requirements.

In conclusion, this analysis indicates that based on current inventory, growth and yield, and forest management information in the Kamloops TSA, the current non-partitioned level of 2 361 900 cubic metres per year can be maintained for the next seventy years before declining by 5% to a long-term harvest level of 2 246 000 cubic metres per year, and the two partition harvests can be maintained for the length of their current obligations.

7 Socio-Economic Analysis

The impact of timber supply adjustments on local communities and the provincial economy is an important consideration in the Timber Supply Review. This socio-economic analysis compares the level of forestry activity currently supported by the timber harvested from the Kamloops TSA to the level of activity that could be supported according to the forecasts presented in the timber supply analysis.

The socio-economic analysis examines the base case harvest forecast, which best represents current forest management practices. Consequently, the socio-economic analysis does not evaluate alternative management scenarios.

The socio-economic analysis includes:

- a profile of the current socio-economic setting;
- a description of the Kamloops TSA forest industry; and
- an analysis of the socio-economic implications of the base case harvest forecast.

The socio-economic analysis considers the current and projected levels of forestry activity associated with the Kamloops TSA within the context of regional timber supplies and production capacity. The profile of the regional and local forest industry is described, and employment and income impacts associated with three main sectors — harvesting and other woodlands-related, processing and silviculture — are estimated. Employment is measured in person-years*. Employment income is calculated using average industry income estimates.

Data on direct employment, harvest levels and fibre flows were obtained by surveying licensees and mill operators. The information was used to estimate harvesting, processing and silviculture direct employment averages associated with the harvest and the proportion of workers living in the area. The estimates of local and provincial harvesting, processing and silviculture direct employment were then used to determine ratios of employment per 1000 cubic metres of timber harvested.

Indirect and induced employment figures were calculated using the Kamloops TSA and provincial employment multipliers* developed by the Ministry of Finance. Indirect impacts result from direct businesses purchasing goods and services; induced impacts result from direct employees purchasing goods and services. Employment coefficients* per 1000 cubic metres were also determined for the indirect and induced impacts.

To estimate the level of employment that could be supported by alternative harvest rates, projected timber supply levels were multiplied by the calculated employment coefficients. Note that employment coefficients are based on current productivity, harvest practices and management assumptions and will not likely reflect industry conditions decades into the future. As such, the employment estimates can only be viewed as indicators of relative size.

7.1 Current socio-economic setting

7.1.1 Overview

The socio-economic analysis focuses on the timber supply from the Kamloops TSA. Located in the southern Interior of the province, the TSA consists of the Kamloops and Clearwater Forest Districts, excluding Tree Farm Licences 35 and 18, and woodlot licences. However, since communities are located throughout the TSA and the employment and economic activity generated by timber harvested in the TFLs is not easily separated, this section profiles the two forest districts, which include the TFLs. In Section 7.3, information describing the socio-economic impacts is based only on the timber supply from the TSA.

Person-year(s)
One person working the equivalent of one full year, defined as at least 180 days of work. Someone working full-time for 90 days accounts for 0.5 person-years.

Employment multiplier
An estimate of the total employment supported by each direct job, for example a multiplier of 2.0 means that one direct job supports one additional indirect and induced job.

Employment coefficient
The number of person-years of employment supported by every 1000 cubic metres of timber harvested; for example, a coefficient of 1.0 indicates that every 1000 cubic metres harvested supports one person-year, or 500 000 cubic metres supports 500 person-years.

7 Socio-Economic Analysis

7.1.2 Population and demographic trends

According to the 1996 Census, the population of the Kamloops and Clearwater Forest Districts increased 14% since 1991 to 101,730 (see Table 5). In comparison, the population of the province also increased by 14% over the same period. The population is concentrated in the City of Kamloops (79,544). Other smaller communities include Ashcroft, Cache Creek, Chase and Logan Lake in the south, and Barriere, Blue River, Clearwater, Little Fort and Vavenby in the north. By the end 2001, the population of the two districts is expected to be about 5% higher, at approximately 106,000.[1]

Table 5. Population trends in the Kamloops TSA (1986–2000)

Community	1986	1991	1996	2000 (est.)	% change/year 1991–1996
Kamloops	63,920	68,842	79,544	82,832	2.9
Logan Lake	2,066	2,436	2,583	2,505	1.2
Chase	1,995	2,132	2,546	2,602	3.6
Ashcroft	1,975	1,756	1,924	1,995	1.8
Cache Creek	1,188	1,033	1,158	1,114	2.3
Other[a]	9,564	13,126	13,975	14,352	1.3
Kamloops TSA	80,708	89,325	101,730	105,400	2.6

Sources: Census of Canada 1986, 1991, 1996.

(a) "Other" includes unincorporated communities such as Clearwater, Blue River, Vavenby, Barriere and Little Fort.

7.1.3 Economic profile

The economy of the Kamloops TSA is well diversified. The City of Kamloops dominates the TSA, with an extensive local economy based on trade, administration, services and manufacturing. Forestry is a significant component of the TSA's economy; however, other important sectors are mining, tourism, manufacturing and the public sector. Highland Valley Copper, located 60 km south of Kamloops, is the third largest copper concentrator in the world and employs about 1,000 people.

Forestry employment is associated with harvesting and silviculture activities, and the processing of wood at about 30 area mills. Weyerhaeuser Company Ltd. is the largest employer in the area, with a large pulp and sawmill employing about 700 people. Weyerhaeuser has recently closed sawmills in the neighbouring Vernon and Merritt Forest Districts and restructured operations at the Kamloops facility to improve production capacity and operating efficiency.

Other TSA manufacturing activity includes a cement plant, concrete product manufacturing, fibreglass, plastics and rubber, furniture, animal feed, food products, metal fabricating, chemicals, machine shops, printing and publishing, and woodwork. The average unemployment rate in the Kamloops Forest Region during 1996 was about 12%, down from 13.5% in 1991, but still higher than the provincial average of 9.6%.

(1) B.C. Stats. Population Section.

7 Socio-Economic Analysis

In 2000, direct forestry-related employment at all TSA mills amounted to approximately 2,100 positions. Harvesting and silviculture activities contribute over 500 additional positions. Non-TSA sources of timber also generate employment in the area (e.g., Tree Farm Licence 18, held by Slocan Forest Products Ltd., and Tree Farm Licence 35, held by Weyerhaeuser Company Ltd.). Woodlot licences, private lands and Indian Reserves contribute additional non-TSA timber. Figure 31 illustrates the shares of total employment by industry sector for the Kamloops TSA.

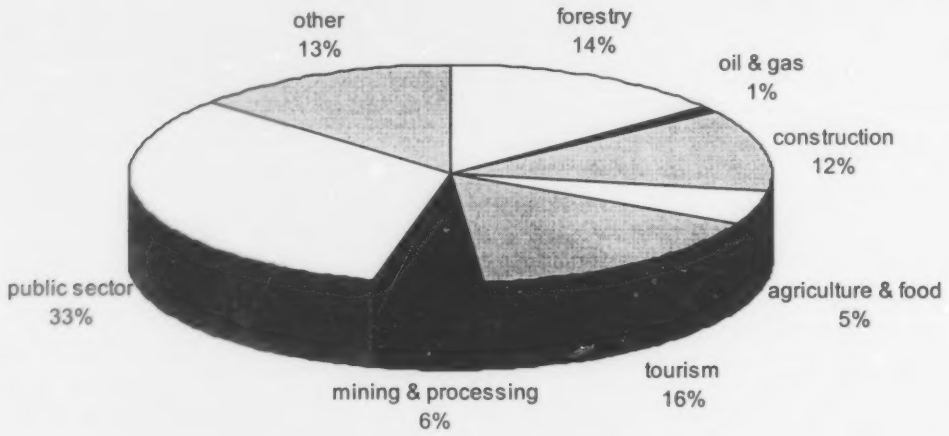

Figure 31. Employment by industry sector — Kamloops TSA, 1996.

Notes: "Forestry" consists of harvesting-related activity and manufacturing. "Other" consists of finance, insurance, real estate and other business services. "Public Sector" consists of local and provincial government, health and education.

Sources: B.C. Ministry of Finance and Corporate Relations. 1999. The 1996 Forest District Tables. Statistics Canada/Census of Canada.

The forest sector supports a significant number of "spin-off" jobs in the region through companies and employees purchasing goods and services from local businesses. This spending is another indicator of the role forestry has in the economy. Each 100 direct forestry jobs in the Kamloops TSA is estimated to support a further 35 to 64 indirect and induced jobs*,[2] depending on the type of forestry activity (logging, pulp and paper, or wood manufacturing) and the associated level of income. The weighted average for the forest sector is 47. In comparison, 100 mining and mineral processing jobs support approximately 39 positions, 100 public sector jobs support 14 additional positions, while 100 tourism jobs support approximately eight positions.

A breakdown of income dependencies (including direct, indirect and induced impacts) further confirms forestry's importance to the economy of the Kamloops TSA. Some 12% of all basic, after-tax income is forestry dependent,[3] accounting for about 15% of all local employment.[4]

> ***Indirect and induced jobs***
> *Indirect jobs are supported by direct business purchases of goods and services. Induced jobs are supported by employee purchases of goods and services; for example, at retail outlets.*

(2) British Columbia Local Area Economic Dependencies and Impact Ratios. February 1995. Ministry of Finance and Corporate Relations.

(3) Ibid.

(4) B.C. Ministry of Finance and Corporate Relations. 1999. The 1996 Forest District Tables.

7 Socio-Economic Analysis

7.2 Kamloops TSA forest industry

7.2.1 Current allowable annual cut

The current allowable annual cut (AAC) for the Kamloops TSA, set in 1996, is 2 679 180 cubic metres, up from the previous level of 2 393 180 cubic metres. The AAC is apportioned into a number of licence types as outlined in Table 6. Eight companies have replaceable forest licences in the TSA accounting for 72% of the total AAC (1 935 000 cubic metres). The remainder is apportioned among several other forms of tenure including timber sale licences and the Small Business Forest Enterprise Program (SBFEP).

Table 6. Kamloops TSA allowable annual cut apportionment, by licence type

	AAC (m^3/year)	Per cent (%)
Forest licences — replaceable	1 935 065	72.2
Forest licences — non-replaceable	182 000	6.8
Small Business Forest Enterprise Program (SBFEP)	402 544	15.1
Timber sale licences	1 813	0.1
Woodlot licences	44 453	1.6
Forest Service reserve	27 305	1.0
Pulpwood agreements	86 000	3.2
Total	2 679 180	100.0

Source: Ministry of Forests.

Note: The Kamloops AAC apportionment includes 31 280 cubic metres per year associated with issued woodlot licences. However, the woodlot volume is not included in the timber supply forecasts.

7.2.2 Kamloops TSA harvest history

The actual annual harvest level is an important indicator of forestry activity in the TSA. While the AAC is the maximum allowable annual harvest level, the actual volume of timber harvested in a particular year indicates the economic activity supported by the TSA. If actual annual harvest levels are consistently less than the AAC, then economic activity is below its full potential. This gap between actual and allowable harvest activity will influence the potential short-term impacts of changes to the AAC.

From 1997 to 2000 approximately 2 615 000 cubic metres of Crown timber was harvested annually from the Kamloops TSA. Harvests from private lands and Indian Reserves, amounting to approximately 107 000 cubic metres per year over the same period, provided non-AAC sources of timber. Other sources of timber and forestry employment in the region are: Slocan Forest Products' TFL 18 with an AAC of 187 000 cubic metres; Weyerhaeuser's TFL 35 with an AAC of 125 600 cubic metres per year, and woodlot licences with a combined AAC of about 56 000 cubic metres. The Kamloops TSA makes up about 35% of the total harvest in the Kamloops Forest Region (9.4 million cubic metres) while the region, in turn, accounts for about 13% of the total provincial harvest (69.7 million cubic metres).

7 Socio-Economic Analysis

Table 7 summarizes the volume of timber harvested in the Kamloops TSA from 1996 to 2000. It indicates a fairly even harvest level over the period, despite provisions for cut control[5] that allow licensees to vary their harvest levels based on operating and market conditions.

Table 7. Kamloops TSA volumes billed, by licence type, 1996–2000

Tenure	Cubic metres (m³)					
	1996	1997	1998	1999	2000	Average 1997-2000
Forest licences	1 996 635	1 706 719	1 656 796	2 030 988	2 038 659	1 858 291
Small Business Forest Enterprise Program (SBFEP)	366 105	431 349	478 066	497 663	575 546	495 656
Other[a]	282 249	227 797	273 460	226 767	315 079	260 776
Total	2 644 989	2 365 865	2 408 322	2 755 418	2 929 284	2 614 722

Source: Ministry of Forests.

(a) "Other" consists of cutting permits such as rights-of-way, road permits and other smaller permits.

7.2.3 Kamloops TSA major licensees

Tolko Industries Ltd.

Tolko Industries Ltd (Tolko) has a replaceable forest licence to harvest 641 088 cubic metres per year in the Kamloops TSA. In addition, Tolko holds five other tenures throughout the province, amounting to 0.9 million cubic metres per year. Tolko also holds a 50% interest in Gilbert Smith Forest Products Ltd. and a minority interest in Riverside Forest Products Ltd., both tenure holders in the TSA.

Tolko is a private, family-owned company whose primary business is the marketing and manufacturing of specialty forest products. Founded in 1961, the company was originally incorporated as Lavington Planer Mill Ltd. Today, Tolko has expanded to eight manufacturing divisions and four marketing and sales divisions, with the corporate office located in Vernon, B.C.

Tolko operates a large plywood and chipping complex in Heffley, about 20 km north of Kamloops. The plant has an annual capacity of 265 million square feet of plywood and veneer and employs about 175 people. The company also operates a lumber mill in Louis Creek, another 50 km north, with additional capacity of 86 million board feet of lumber, also employing 175 people. In 2000 these two facilities utilized about 800 000 cubic metres of timber. Table 8 outlines Tolko's recent harvest activity in the Kamloops TSA and associated employment levels for the year 2000.

(5) A licensee's harvest may differ from the AAC by up to 50% annually, although the average harvest must be within 10% of the AAC over each five-year period.

Table 8. Tolko Industries Ltd. harvest and direct employment statistics

Forest licence AAC	641 088 cubic metres
2000 harvest	660 279 cubic metres
1997-2000 average harvest	624 859 cubic metres
Direct employment (person-years)	
Harvesting, silviculture and administration	217
Processing	357

Note: The employment figures relate to the volumes harvested from the Kamloops TSA land base only.

Weyerhaeuser Company Ltd.

Weyerhaeuser Company Ltd. (Weyerhaeuser) has a replaceable forest licence to harvest 456 276 cubic metres per year in the Kamloops TSA. Table 9 summarizes the harvest activity and year 2000 employment associated with Weyerhaeuser's operations in the Kamloops TSA.

In Canada, Weyerhaeuser began operations in 1965, growing to become one of the largest forest products companies in Western Canada based on sales and assets, and one of the most significant tenure holders in B.C. Canadian operations account for a significant share of Weyerhaeuser's North American activities. Canadian manufacturing represents about 17% of all Weyerhaeuser pulp and paper production, 34% of all softwood lumber output and 58% of oriented strand board (OSB) capacity.

Weyerhaeuser operates four sawmills in British Columbia's southern Interior including facilities in Kamloops and in Vavenby, about 100 km north of Kamloops. The Kamloops and Vavenby operations have a combined annual capacity of close to 200 million board feet of lumber and employ about 270 people. Weyerhaeuser has also operated a pulp plant in Kamloops since 1965. Kamloops Pulp produces three grades of bleached and semi-bleached softwood kraft pulp. The fibre supply for the pulp mill is drawn from local sawmill residues such as wood chips, sawdust, planer shavings and hog fuel. The mill employs 600 people with a production capacity of approximately 442 000 metric tonnes a year.

Table 9. Weyerhaeuser Canada Ltd. harvest and direct employment statistics

Forest licence AAC	456 276 cubic metres
2000 harvest	487 918 cubic metres
1997-2000 average harvest	446 250 cubic metres
Direct employment (person-years)	
Harvesting, silviculture and administration	146
Processing	603

Note: Employment figures relate to the volumes harvested from the Kamloops TSA land base only.

7 Socio-Economic Analysis

Slocan Forest Products Ltd.

Slocan Forest Products Ltd. (Slocan) has a replaceable forest licence to harvest 269 638 cubic metres per year in the Kamloops TSA. Slocan has numerous other tenures throughout the province and is the third largest licence holder in the B.C. Interior with 5.6 million cubic metres per year.

Across the province, Slocan has interests in eight sawmills that produce dimension lumber and by-product wood chips. The mills are located at Engen, Fort Nelson, Mackenzie, Quesnel, Radium Hot Springs, Slocan, Valemount and Vavenby, which is in the Clearwater Forest District portion of the Kamloops TSA.

Since Slocan acquired the operation in 1987, the Vavenby sawmill has been totally rebuilt, using the latest sawmill technology. Slocan-Vavenby is now one of the most modern, random length mills in the province. The sawmill produces high quality dimension lumber and is one of the few mills in the province specializing in long length lumber (18' to 24') to meet market demand for higher value product. Slocan's Vavenby mill employs about 150 people and has an annual capacity of 150 million board feet of lumber.

Table 10 outlines Slocan's recent harvest activity in the Kamloops TSA and year 2000 employment levels.

Table 10. Slocan Forest Products Ltd. harvest and direct employment statistics

Forest licence AAC	269 638 cubic metres
2000 harvest	292 329 cubic metres
1997-2000 average harvest	210 390 cubic metres
Direct employment (person-years)	
Harvesting, silviculture and administration	104
Processing	87

Note: The employment figures relate to the volumes harvested from the Kamloops TSA land base only.

7 Socio-Economic Analysis

International Forest Products Ltd.

International Forest Products Ltd. (Interfor) has a replaceable forest licence to harvest 249 594 cubic metres per year in the Kamloops TSA and is British Columbia's sixth largest tenure holder at 3.4 million cubic metres per year.

International Forest Products Ltd. is one of western Canada's largest logging and sawmilling companies. Its west coast operations extend from Hope to Prince Rupert. The company manufactures both structural and specialty products and markets them worldwide. Its Adams Lake Lumber plant, built in 1942, is about an hour's drive east of Kamloops. It is Interfor's only division in the B.C. Interior and turns out whitewood products mainly for the North American market. The mill produces 110 million board feet of lumber per year and employs 175 people.

Table 11 summarizes the harvest activity and 2000 employment associated with Interfor's operations in the Kamloops TSA.

Table 11. International Forest Products Ltd. harvest and direct employment statistics

Forest licence AAC	249 594 cubic metres
2000 harvest	244 144 cubic metres
1997-2000 average harvest	239 853 cubic metres
Direct employment (person-years)	
Harvesting, silviculture and administration	66
Processing	105

Note: The employment figures relate to the volumes harvested from the Kamloops TSA land base only.

West Fraser Mills Ltd.

West Fraser Mills Ltd. (West Fraser) has recently purchased (from Ainsworth Lumber Co. Ltd.) a replaceable forest licence to harvest 209 124 cubic metres per year in the Kamloops TSA. West Fraser is also a large licence holder in B.C. — its numerous other licences in the province amount to over 4.7 million cubic metres per year. Table 12 outlines recent harvest activity in the TSA related to West Fraser's forest licence, and its year 2000 employment levels for TSA operations. West Fraser only recently acquired this licence; historical statistics were actually undertaken by Ainsworth when that company held the licence.

West Fraser began operations in 1955 and is now an integrated forest products company producing dimension lumber and related solid wood products, fibreboard, pulp, linerboard, kraft paper and newsprint. The company also owns and operates a chain of retail home improvement stores in Canada.

West Fraser does not have processing facilities in the TSA, but does have interests in nine sawmills producing dimension lumber and by-product wood chips in the Cariboo, Prince George and Prince Rupert forest regions. West Fraser's sells lumber from its retail and wholesale customers and lumber brokers. In 1998, 72% of lumber sales were to customers in the United States and 25% to Canadian customers, who resold a significant portion into the United States. Asian and other customers accounted for the remaining 3% of sales. Most of the sales to North American customers are shipped by rail directly from the sawmills. The remainder is shipped by truck, or by water through West Fraser's deep-sea terminal at Kitimat.

Table 12. West Fraser Mills Ltd. harvest and direct employment statistics (based on historical Ainsworth activities)[a]

Forest licence AAC	209 124 cubic metres
2000 harvest	136 238 cubic metres
1997-2000 average harvest	176 919 cubic metres
Direct employment (person-years)	
Harvesting, silviculture and administration	48
Processing	210

(a) The employment figures relate to the volumes harvested from the Kamloops TSA land base only.

Ainsworth Lumber Co. Ltd.

Ainsworth Lumber Co. Ltd (Ainsworth) is a Western Canada based manufacturer of forest products with operations in British Columbia and Alberta. Products are distributed to markets throughout North America, the Pacific Rim, Europe and South America. Ainsworth's B.C. operations currently include a large OSB mill in 100 Mile House, a veneer plant in Lillooet (Lillooet TSA), and a specialty plywood plant in Savona (Kamloops TSA).

The Savona operation, about 30 km west of Kamloops, produces overlaid plywood products used as concrete forming material for high rise construction, dams and highway infrastructure. The Lillooet veneer plant supplies the Savona facility with the Douglas-fir veneer used to produce the overlaid plywood. During 1997 the Savona mill produced about 95 million square feet of plywood and employed 210 people.

Ainsworth Lumber Co. Ltd (Ainsworth) has part of its Pulpwood Agreement (PA) 16 in the Kamloops TSA; the associated volume is a partitioned level of 86 000 cubic metres for the harvest of previously unmerchantable forest types. PA 16 also covers parts of the Lillooet, Williams Lake and 100 Mile House TSAs. The pulpwood agreement only allows additional timber to be harvested when wood supply from other sources is insufficient. Recently, Ainsworth sold the forest licence it held in the Kamloops TSA to West Fraser.

Other licensees

Other licensees in the Kamloops TSA consist of Gilbert Smith Forest Products Ltd. with a total AAC of 135 940 cubic metres in both replaceable and non-replaceable forest licences (FLs), Riverside Forest Products Ltd. (34 133 cubic metre replaceable FL), Bell Pole Co. (13 272 cubic metre replaceable FL), and Small Business Forest Enterprise Program participants with a combined AAC apportionment of 402 544 cubic metres. From 1997 to 2000, SBFEP harvests averaged 495 656 cubic metres annually, which would normally support approximately 500 harvesting, silviculture and processing person-years.

Other processing facilities

In addition to the mills previously discussed, a number of other processing facilities within the TSA and in adjoining TSAs rely on fibre from the Kamloops TSA (Table 13).

Table 13. Other processing facilities within the Kamloops TSA

Facility	Location	Primary product	Employment
Paul Creek Slicing Ltd.	Kamloops	Veneer	50
Gilbert Smith Forest Products Ltd.	Barriere	Lumber	47
Simpcw Development Co. Ltd.	Barriere	Lumber	18
Meeker Log and Timber Ltd.	Kamloops	Shake and shingle blocks	27
Cache Creek Woodchips Ltd.	Cache Creek	Wood chips	22
Odermatt Log Home Manufacturing Ltd.	Kamloops	Log homes	15
Davis Lake Cedar Ltd.	Squilax	Shake & shingle	12
Granberg Construction Ltd.	Kamloops	Log homes	12
Wadlegger Log and Construction Co.	Raft River	Lumber	12
Canadian Frontier Log Homes Ltd.	Kamloops	Log homes	10

7.2.4 Forest sector employment summary

In this section, the preceding harvesting and employment information is considered in the development of employment coefficients used to project future employment levels. For this purpose, the forest sector has been divided into the following three sub-sectors:

- harvesting and other woodlands-related employment such as log salvage and log scaling, and planning;
- silviculture activity including all planting and other basic and intensive operations; and
- timber processing employment.

Harvesting and silviculture employment

The harvesting sub-sector of the forest industry includes both company and contract loggers and is the most closely tied to the AAC. Consequently, harvest level changes will affect this sub-sector first, and in close to the same proportions.The silviculture sub-sector is less linked to the current level of harvest, since silviculture activities occur at least three to six years after harvesting. Silviculture activity is divided into basic and enhanced work. Basic silviculture consists of surveys, site preparation, planting, brushing, cone collecting and some spacing. Enhanced, or intensive, silviculture includes spacing, fertilizing and pruning*. In the Kamloops TSA, licensees are responsible for basic silviculture on areas harvested under forest licences. The provincial government is responsible for the remaining basic and all enhanced silviculture on Crown land, which is normally completed by silviculture contractors.

Primary timber processing employment

Processing facilities in the TSA rely on the Kamloops TSA and other TSAs, TFLs and private lands in the area for their timber supply. Timber from the Kamloops TSA also supports processors located throughout the region and province.

Forest Service employment

The Kamloops and the Clearwater Forest District offices jointly administer the Kamloops TSA. Currently, about 110 people work in the two district offices. Since Forest Service activities are related more to the administration and enforcement of government policy than to the timber harvest, these jobs are not included in the analysis of forestry sector impacts.

Kamloops TSA forestry employment and employment coefficient summary

Table 14 summarizes employment supported by the 1997–2000 average harvest in the Kamloops TSA, and the corresponding employment coefficients. The employment and coefficients are separated into two groups:

- TSA employment and employment coefficients, which comprise residents of the Kamloops TSA who are employed within the Kamloops TSA; and
- Provincial employment and employment coefficients, which comprise all forest sector employment in the province that relies on the Kamloops timber supply, including both residents of the Kamloops TSA and those who live elsewhere.

Calculations have been made for both groups to identify the importance of the forest sector within the Kamloops TSA and to highlight the contribution that the Kamloops TSA's forest sector makes to the provincial economy.

The average annual harvest from the timber supply area, from 1997 to 2000, was 2 615 000 cubic metres, 1.2% below the AAC.

Pruning
The manual removal of the lower branches of crop trees to a predetermined height to produce clear, knot-free wood.

Table 14. Kamloops TSA employment and employment coefficients

Activity	TSA person-years	TSA coefficients	Provincial person-years	Provincial coefficients
Harvesting	503	0.19	591	0.22
Silviculture	210	0.08	247	0.09
Processing	1,521	0.58	1,601	0.61
Total direct	2,234	0.85	2,439	0.93
Indirect + induced	1,459	0.56	2,637	1.01
Total employment	3,693	1.41	5,076	1.94

Note: Employment estimates are person-years based on average 1997-2000 employment levels and the average 1997–2000 harvest of 2 615 000 cubic metres. Person-years do not indicate individual jobs. Wood products transport, and road building and maintenance are included in indirect estimates. For further discussion, see Appendix B.

More detailed information regarding employment coefficients is presented in Appendix B, "Socio-Economic Analysis Background Information."

7.2.5 Kamloops TSA employment income

From 1998 to 2000 the average annual income for direct forest sector employees in the Kamloops TSA was approximately $47,500, and $30,800 for indirect and induced employment (in 1999 dollars). Based on these averages, current harvesting, silviculture and processing of timber from the Kamloops TSA generates an estimated $116 million in direct wages and salaries and $81 million in indirect and induced wages and salaries annually throughout the province (see Table 15).

Table 15. Average annual direct and indirect and induced incomes and total employment income, 1997–2000

	Average annual income (1999 dollar value)	Total annual income ($ millions)	Total income ($/000s m³)
Direct	47,500	116	44,375
Indirect + induced	30,800	81	30,975
Total income		197	75,350

Source: Statistics Canada, Survey of Employment Payrolls and Hours.

7.2.6 Provincial government revenues

Provincial government revenues from the forestry industry include stumpage, royalties and rent payments; other taxes such as logging, corporate capital, sales, property and electricity taxes; and income taxes from direct, indirect and induced employees.

From 1997 to 2000, average stumpage and rent payments for Crown timber in the Kamloops TSA were approximately $58.5 million per year. Forest and corporate taxes and revenues generated $19.4 million, while employment supported by the Kamloops TSA timber harvest accounted for $16.9 million in provincial income taxes (see Table 16).

Table 16. Average annual provincial government revenues, 1997–2000

	Average annual revenue 1997-2000 ($ 1999 millions)	Revenue ($/000s m³)
Stumpage, rents and royalties	58.5	22,375
Industry taxes	19.4	7,425
Provincial income tax	16.9	6,450
Total government revenues	94.8	36,250

7.3 Socio-economic implications of the base case harvest forecast

The base case harvest forecast suggests that timber supply from conventionally harvested stands (2 361 900 cubic metres per year) is stable and can be maintained for 70 years. Partitions of 200 000 cubic metres per year for old cedar/hemlock stands, and 86 000 cubic metres per year for Pulpwood Agreement 16 are projected to be maintained for 10 and 20 years, respectively. The resulting forecast maintains the current total AAC of 2.65 million cubic metres for 10 years, declining by 7.6% after decade 1, by a further 3.5% after decade 2 to the conventional harvest level, and finally by 4.9% after decade 7 to reach the long-term harvest level of 2 246 000 cubic metres. The socio-economic analysis focuses on the base case harvest level changes in this short- to medium-term period, and considers:

- the short- and long-term implications of alternative harvest levels for both the Kamloops TSA and the province;
- possible impacts on the communities within the TSA;
- timber requirements of processing facilities within the Kamloops TSA; and
- regional timber supply implications.

The socio-economic analysis considers the average levels of forestry activity that the base case harvest forecast could support, assuming that employment changes by the same percentage as the harvest level, and that the proportion of harvesting, processing and silviculture employment remains the same. Since the analysis also assumes that the types and proportions of products manufactured remain constant, it does not attempt to predict how timber flows, technology or product lines may change in response. The analysis indicates the size of impacts to expect within a constantly changing socio-economic environment.

Employment and income impacts are divided into direct, indirect and induced components; the sum of all the components is the total impact. Direct impacts reflect harvesting, silviculture and processing activity. Indirect impacts are the result of direct businesses purchasing goods and services, and induced impacts are the result of direct and indirect employees spending their incomes on consumer goods and services.

7 Socio-Economic Analysis

Table 17 provides estimates for the range of impacts that the base case harvest forecast may have on employment and income. Ranges are used to reflect the availability of employment insurance and social assistance payments, and their mitigating effects in the shorter term. The lower end of the range reflects induced impacts that are diminished in the short term, because income from employment insurance and social assistance supports displaced workers. The upper end of the range represents long-term impacts when displaced workers leave the area, and local spending patterns are more fundamentally affected. In reality, a combination of three scenarios — some workers accessing social assistance payments, some finding alternate employment and some leaving the area completely — is more likely to occur.

7.3.1 Short- and long-term implications of alternative harvest levels

Kamloops TSA employment and income impacts

For accounting purposes, TSA employment and income includes only that of workers who are supported by the TSA harvest and who reside within the TSA. Workers who come to the TSA to work but who reside outside the TSA are included in the provincial impact section, as is employment supported by Kamloops TSA timber processed at mills outside the TSA. Table 17 indicates the employment and income that could be supported within the Kamloops TSA by the base case harvest forecast. If fully harvested and processed, the current AAC of 2 679 000 cubic metres could support approximately 2,289 person-years of direct employment and another 1,495 indirect and induced person-years of employment within the timber supply area. Approximately $114 million (1999 dollar value) total after-tax annual income would be supported by the Kamloops TSA timber supply.

By decade 8, the reduced timber supply of 2 246 000 cubic metres per year would support approximately 1,941 person-years of direct employment and 1,253 person-years of indirect and induced employment; a reduction of about 16% (approximately 612 person-years). Total after-tax employment income would decline from current levels by approximately $15.7 million to $81.4 million per year.Approximately 92% of all direct employees reside within the Kamloops TSA. The specific location of impacts will depend on how timber flows change and how industry adapts to changes in timber supply. Kamloops TSA processing also depends on the regional timber supply.

Provincial employment and income impacts

Provincial employment and income impacts include all forest sector employment supported by the timber harvested from the Kamloops TSA. Assuming the current AAÇ of 2 679 000 cubic metres is fully harvested and processed, the Kamloops TSA can support about 2,500 person-years of direct forestry employment and a further 2,700 person-years of indirect and induced employment across the province. After 70 years, the forecasted timber supply of 2 246 000 cubic metres per year would lower total employment potential by about 840 person-years; about half of these would be direct forestry jobs.

Provincial government revenue impacts

Based on current tax and stumpage rates, the AAC of 2 679 000 cubic metres has the potential to provide approximately $97 million annually to the provincial government (1999 dollar value), just $2.3 million more than the actual harvest level generates. After 70 years, if the timber supply is reduced to 2 246 000 cubic metres, annual provincial government revenues would fall to about $81.4 million, assuming current taxation and stumpage rates do not change.

7 Socio-Economic Analysis

Table 17. Socio-economic impacts of the Kamloops TSA base case forecast

	Current AAC	Total harvest (conventional + partitions)[a] years 1–10	Conventional + PA 16 years 11–20	Conventional only 21–70 years	Long-term conventional only 71+ years
Timber supply ('000s m³)					
AAC[b]	2 679	2 648	2 448	2 362	2 246
Kamloops TSA					
Employment			**(person-years)**		
Direct	2,289	2,262	2,091	2,017	1,918
Indirect + induced	1,495	1,477	1,366	1,318	1,253
Total	3,783	3,739	3,457	3,335	3,171
Cumulative change in total person-years		– 362 to 274	– 620 to – 33	– 732 to – 164	– 881 to – 342
Employment income			**($ 1999 million)**		
Direct	78.4	77.5	71.6	69.1	65.7
Indirect + induced	35.4	35.0	32.4	31.2	29.7
Total	113.8	112.5	104.0	100.3	95.4
Cumulative change in total income		– 8.9 to 6.2	– 16.8 to – 2.9	– 20.25 to – 6.8	– 24.8 to – 12.0
Province (includes Kamloops TSA)					
Employment			**(person-years)**[c]		
Direct	2,499	2,470	2,284	2,203	2,095
Indirect + induced	2,701	2,670	2,468	2,382	2,265
Total	5,201	5,140	4,752	4,585	4,360
Cumulative change in total person-years		– 504 to 383	– 859 to – 39	– 1,012 to – 220	– 1,217 to – 465
Employment income			**($ 1999 million)**		
Direct	85.6	84.6	78.2	75.4	71.7
Indirect + induced	64.1	63.3	58.5	56.5	53.7
Total	149.6	147.9	136.7	131.9	125.4
Cumulative change in total income		– 12.3 to 8.8	– 22.6 to – 3.2	– 27.1 to – 8.3	– 33.1 to – 15.3
Provincial government revenues			**($ 1999 million)**		
Provincial income tax	17.3	17.1	15.8	15.2	14.5
Stumpage and rent	59.9	59.2	54.8	52.8	50.2
Other B.C. revenues	19.9	19.7	18.2	17.5	16.7
Total B.C. revenues	97.1	96.0	89.7	85.6	81.4
Cumulative changes in total revenue		– 2.2 to – 0.1	– 9.3 to – 7.4	– 12.4 to – 10.6	– 16.6 to – 14.8

(a) The first decade harvest comprises a conventional harvest of 2 361 900 cubic metres per year, adjusted downwards by 31 280 cubic metres to account for allocated woodlot licences, and partitions of 200 000 cubic metres for old cedar and hemlock stands, and 86 000 cubic metres for PA 16.

(b) Estimates for current employment and income differ from those in Tables 14 and 15. Employment figures in Table 17 are based on the current AAC of 2 679 000 cubic metres, while the figures in Table 14 are based on the 1997–2000 average harvest level of 2 615 000 cubic metres (64 000 cubic metres less than the current total AAC). Income figures in Table 17 are net of taxes while those of Table 15 are gross income.

(c) Provincial employment includes both Kamloops TSA employment and employment supported outside the TSA by Kamloops TSA harvested timber.

The ranges for employment and income changes take into consideration employment insurance and other social assistance programs. The range's upper limit is based on the assumption that all those who are unemployed will leave the TSA. The lower limit is based on the assumption that employment insurance and other social assistance payments will reduce the induced impacts of a lower harvest level.

7.3.2 Community-level impacts

Estimates of impacts related to changes in Kamloops TSA timber supply should be placed in the context of the growing and fairly diverse economy of the area. The more diversified the region the less effect changes in any one sector will have on the regional economy. For less diversified and more remote communities, any reduction to timber supply may lead to population declines and alter the structure of the local economy.

The Kamloops TSA timber harvest provides roughly 13% of the basic employment in the TSA. It would be expected that changes to the timber supply would have a significant impact on the overall economic trends of the region. However, considering that the year 2000 actual harvest levels were 10% above the AAC, and that the year 2000 processing employment was 7% below the 1997-2000 average level, the impacts of the total AAC reduction (16% in the long term) could well be tempered. The harvesting and primary processing components of the forestry industry are expected to decline in the TSA over the long term.

In the Kamloops TSA, the vicinity of Kamloops (city) is most dependent on the forest sector. The communities in this surrounding area may be more adversely affected as regional timber supplies decline.

7.3.3 Nature, production capabilities and timber requirements of processing facilities

Assuming that a reduction in the Kamloops TSA timber supply is spread evenly among tenures, the 16% reduction by decade 8 may have only a minor effect on local processing activity. The reduction results in an AAC only 5% below the 1997 harvest level, a level that supported only 100 less direct jobs than does the current AAC. However, over the very long term, the harvesting and primary processing components of the forestry industry in the TSA are expected to decline.

7.3.4 Regional timber supply implications

About 80% of the total milling requirements — 3.5 million cubic metres per year — of the processing facilities in the Kamloops TSA is harvested from the timber supply area.

The future of the regional timber supply is also important to primary processing facilities in the Kamloops TSA. In the Kamloops Forest Region, the previous timber supply review led to a decrease in the conventional AAC of 0.7%, or about 55 000 cubic metres, while the total AAC increased by 6.3% due to partitions for smaller and lower quality timber. In two to three decades the annual timber supply from the Kamloops Forest Region may fall by another 2.5%, or 175 000 cubic metres, assuming the forests are managed according to the latest round of Timber Supply Reviews.

Mill-level impacts will not occur solely due to the volume of timber harvested from the Kamloops TSA; they also result from harvest changes that occur across the region. It is impossible to predict, however, which mills and regions will be most affected, or if new "value added" operations will offset or exacerbate some of these changes.

7.4 Summary

The forestry sector is an important source of employment and income for the Kamloops TSA. The TSA's processing facilities require 3.5 million cubic metres per year, about 80% of which comes from the Kamloops TSA. The current AAC for the Kamloops TSA is 2 679 180 cubic metres. If the AAC is fully harvested and processed, it can support approximately 2,500 person-years of direct employment across the province and a further 2,700 indirect and induced jobs.

The base case harvest forecast suggests that timber supply from conventionally harvested stands (2 361 900 cubic metres per year) is stable and can be maintained for 70 years. Partitions of 200 000 cubic metres per year for old cedar/hemlock stands, and 86 000 cubic metres per year for Pulpwood Agreement 16 are projected to be maintained for 10 and 20 years, respectively. The resulting forecast maintains the current total AAC of 2.65 million cubic metres for 10 years, declining in three steps (after decades 1, 2 and 7) to the long-term harvest level of 2 246 000 cubic metres. This reduction would lower direct employment by close to 400 person-years, and indirect and induced employment by a further 436 person-years. By that time, the Kamloops TSA would support approximately 2,095 person-years of direct employment and 2,265 person-years of indirect and induced employment.

Regional effects could be in sharp contrast to individual community impacts. The Kamloops economy is not as dependent on forestry as some of the other less diversified communities across the province, and projected changes to the forestry sector could be diminished by economic growth in other basic sectors*. Smaller communities, especially in the Kamloops (city) area, are the most vulnerable to forest sector changes. Individuals who lose their jobs in any sector often face financial and emotional difficulties, and the specialized skills acquired in forestry jobs are often not easily transferable to other employment.

Basic sector
Sectors of the economy, such as forestry, tourism and mining, that create flows of income into the region and are assumed to be drivers of the local economy. Non-basic sectors, such as retail outlets, are supported by basic sectors.

8 References

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9 Glossary

Allowable annual cut (AAC)	The rate of timber harvest permitted each year from a specified area of land, usually expressed as cubic metres of wood per year.
Analysis unit	A grouping of types of forest — for example, by species, site productivity, silvicultural treatment, age, and or location — done to simplify analysis and generation of timber yield tables.
Base case harvest forecast	The timber supply forecast which illustrates the effect of current forest management practices on the timber supply using the best available information, and which forms the reference point for sensitivity analysis.
Basic sector	Sectors of the economy, such as forestry, tourism and mining, that create flows of income into the region and are assumed to be drivers of the local economy. Non-basic sectors, such as retail outlets, are supported by basic sectors.
Biodiversity (biological diversity)	The diversity of plants, animals and other living organisms in all their forms and levels of organization, including the diversity of genes, species and ecosystems, as well as the evolutionary and functional processes that link them.
Biogeoclimatic (BEC) variant	A subdivision of a biogeoclimatic subzone. Variants reflect further differences in regional climate and are generally recognized for areas slightly drier, wetter, snowier, warmer or colder than other areas in the subzone.
Biogeoclimatic zones	A large geographic area with broadly homogeneous climate and similar dominant tree species.
Coniferous	Coniferous trees have needles or scale-like leaves and are usually 'evergreen'.
Cutblock	A specific area, with defined boundaries, authorized for harvest.
Cutblock adjacency	The desired spatial relationship among cutblocks. Most adjacency restrictions require that recently harvested areas must achieve a desired condition (green-up) before nearby or adjacent areas can be harvested. Specifications for the maximum allowable proportion of a forested landscape that does not meet green-up requirements are used to approximate the timber supply impacts of adjacency restrictions.
Deciduous	Deciduous trees shed their leaves annually and commonly have broad-leaves.

9 Glossary

Early seral

Stands are defined as early seral if they are younger than 40 years of age. An exception is deciduous-dominated stands in the Boreal White and Black Spruce biogeoclimatic zone, which are defined as early seral up to 20 years of age.

Employment coefficient

The number of person-years of employment supported by every 1000 cubic metres of timber harvested; for example, a coefficient of 1.0 indicates that every 1000 cubic metres harvested supports one person-year, or 500 000 cubic metres supports 500 person-years.

Employment multiplier

An estimate of the total employment supported by each direct job, for example a multiplier of 2.0 means that one direct job supports one additional indirect and induced job.

Environmentally sensitive areas

Areas with significant non-timber values, fragile or unstable soils, impediments to establishing a new tree crop, or high risk of avalanches.

Forest cover objectives

Specify desired distributions of areas by age or size class groupings. These objectives can be used to reflect desired conditions for wildlife, watershed protection, visual quality and other integrated resource management objectives. General adjacency and green-up guidelines are also specified using forest cover objectives (see **Cutblock adjacency and Green–up**).

Forest inventory

An assessment of British Columbia's timber resources. It includes computerized maps, a database describing the location and nature of forest cover, including size, age, timber volume, and species composition, and a description of other forest values such as recreation and visual quality.

Forest Practices Code

Legislation, standards and guidebooks that govern forest practices and planning, with a focus on ensuring management for all forest values.

Forest type

The classification or label given to a forest stand, usually based on its tree species composition. Pure spruce stands and spruce-balsam mixed stands are two examples.

9 Glossary

Free-growing	An established seedling of an acceptable commercial species that is free from growth-inhibiting brush, weed and excessive tree competition.
Green-up	The time needed after harvesting for a stand of trees to reach a desired condition (usually a specific height) — to ensure maintenance of water quality, wildlife habitat, soil stability or aesthetics — before harvesting is permitted in adjacent areas.
Growing stock	The volume estimate for all standing timber at a particular time.
Harvest forecast	The flow of potential timber harvests over time. A harvest forecast is usually a measure of the maximum timber supply that can be realized over time for a specified land base and set of management practices. It is a result of forest planning models and is affected by the size and productivity of the land base, the current growing stock, and management objectives, constraints and assumptions.
Higher level plans	Higher level plans establish the broader, strategic context for operational plans, providing objectives that determine the mix of forest resources to be managed in a given area.
Improved stock	Trees selected from the natural population with better than average characteristics such as growth rates.
Indirect and induced jobs	Indirect jobs are supported by direct business purchases of goods and services. Induced jobs are supported by employee purchases of goods and services; for example, at retail outlets.
Inoperable areas	Areas defined as unavailable for harvest for terrain-related or economic reasons. Characteristics used in defining inoperability include slope, topography (e.g., the presence of gullies or exposed rock), difficulty of road access, soil stability, elevation and timber quality. Operability can change over time as a function of changing harvesting technology and economics.
Land and Resource Management Plan (LRMP)	A strategic, multi-agency, integrated resource plan at the subregional level. It is based on the principles of enhanced public involvement, consideration of all resource values, consensus-based decision making, and resource sustainability.
Landscape-level biodiversity	The *Landscape Unit Planning Guide* provides objectives for maintaining biodiversity at both the landscape level and the stand level. At the landscape level, guidelines are provided for the maintenance of seral stage distribution, patch size distribution and landscape connectivity.

9 Glossary

Landscape unit

A planning area based on topographic or geographic features, that is appropriately sized (up to 100 000 hectares), and designed for application of landscape-level biodiversity objectives.

Long-term harvest level

A harvest level that can be maintained indefinitely given a particular forest management regime (which defines the timber harvesting land base, and objectives and guidelines for non-timber values) and estimates of timber growth and yield.

Management assumptions

Approximations of management objectives, priorities, constraints and other conditions needed to represent forest management actions in a forest planning model. These include, for example, the criteria for determining the timber harvesting land base, the specification of minimum harvestable ages, utilization levels, integrated resource guidelines and silviculture and pest management programs.

Mature seral

Forest stands with trees between 80 and 120 years old, depending on species, site conditions and biogeoclimatic zone.

Mean annual increment (MAI)

Stand volume divided by stand age. The age at which average stand growth, or MAI, reaches its maximum is called the culmination age (CMAI). Harvesting all stands at this age results in a maximum average harvest over the long term.

Model

An abstraction and simplification of reality constructed to help understand an actual system or problem. Forest managers and planners have made extensive use of models, such as maps, classification systems and yield projections, to help direct management activities.

Natural disturbance type (NDT)

An area that is characterized by a natural disturbance regime, such as wildfires, which affects the natural distribution of seral stages. For example areas subject to less frequent stand-initiating disturbances usually have more older forests.

Non-merchantable forest types

Stands that are accessible and otherwise available for harvesting but are assumed to be non-merchantable due to stand characteristics such as small piece size, incidence of decay, species composition and low stocking.

Not satisfactorily restocked (NSR) areas

An area not covered by a sufficient number of well-spaced tree stems of desirable species. Stocking standards are set by the B.C. Forest Service. Areas harvested prior to October 1987 and not yet sufficiently stocked according to standards are classified as backlog NSR. Areas harvested or otherwise disturbed since October 1987 are classified as current NSR.

9 Glossary

Old seral	Old seral refers to forests with appropriate old forest characteristics. Ages vary depending on forest type and biogeoclimatic variant.
Operability	Classification of an area considered available for timber harvesting. Operability is determined using the terrain characteristics of the area as well as the quality and quantity of timber on the area.
Partition	A portion of the AAC that is attributable to certain types of timber and/or terrain.
Person-year(s)	One person working the equivalent of one full year, defined as at least 180 days of work. Someone working full-time for 90 days accounts for 0.5 person-years.
Protected area	A designation for areas of land and water set aside to protect natural heritage, cultural heritage or recreational values (may include national park, provincial park, or ecological reserve designations).
Pruning	The manual removal of the lower branches of crop trees to a predetermined height to produce clear, knot-free wood.
Pulpwood agreements	An agreement applying to a fixed geographic area that allows harvesting of timber below sawlog standards if mill residues suitable for the facility under the agreement are not available.
Riparian area	Areas of land adjacent to wetlands or bodies of water such as swamps, streams, rivers or lakes.
Scenic area	Any visually sensitive area or scenic landscape identified through a visual landscape inventory or planning process carried out or approved by a district manager.
Selection management	A silvicultural system used to maintain or create areas containing a wide range of tree ages or sizes. The time interval between harvests in such areas is fairly short (usually less than 30 years), and during these harvests either single scattered trees or small groups of trees are removed from across the entire area.
Sensitivity analysis	A process used to examine how uncertainties about data and management practices could affect timber supply. Inputs to an analysis are changed, and the results are compared to a baseline or base case.
Seral stages	Sequential stages in the development of plant communities that successively occupy a site and replace each other over time.

9 Glossary

Silvicultural treatments	Activities that ensure the regeneration of young forests on harvested areas, enhance tree growth or improve wood quality in selected stands. Activities include: site rehabilitation and preparation, planting, spacing, fertilization and pruning.
Site index	A measure of site productivity. The indices are reported as the average height, in metres, that the tallest trees in a stand are expected to achieve at 50 years (age is measured at 1.3 metres above the ground). Site index curves have been developed for British Columbia's major commercial tree species.
Stand-level biodiversity	A stand is a relatively localized and homogeneous land unit that can be managed using a single set of treatments. In stands, objectives for biodiversity are met by maintaining specified stand structure (wildlife trees or patches), vegetation species composition and coarse woody debris levels.
Stocking	The proportion of an area occupied by trees, measured by the degree to which the crowns of adjacent trees touch, and the number of trees per hectare.
Table Interpolation Program for Stand Yields	A B.C. Forest Service computer program used to generate yield projections for managed stands based on interpolating from yield tables of a model (TASS) that simulates the growth of individual trees based on internal growth processes, crown competition, environmental factors and silvicultural practices.
Timber harvesting land base	Crown forest land within the timber supply area where timber harvesting is considered both acceptable and economically feasible, given objectives for all relevant forest values, existing timber quality, market values and applicable technology.
Timber supply	The amount of timber that is forecast to be available for harvesting over a specified time period, under a particular management regime.
Timber supply area (TSA)	An integrated resource management unit established in accordance with *Section 7* of the *Forest Act*.
Tree farm licence (TFL)	Provides rights to harvest timber, and outlines responsibilities for forest management, in a particular area.

9 Glossary

Ungulate	A hoofed herbivore, such as deer.
Unsalvaged losses	The volume of timber killed or damaged annually by natural causes (e.g., fire, wind, insects and disease) that is not harvested.
Variable Density Yield Prediction model	An empirical yield prediction system supported by the B.C. Forest Service, designed to predict average yields and provide forest inventory updates over large areas (i.e., Timber Supply Areas). It is intended for use in unmanaged natural stands of pure or mixed composition.
Visual quality objective (VQO)	Defines a level of acceptable landscape alteration resulting from timber harvesting and other activities. A number of visual quality classes have been defined on the basis of the maximum amount of alteration permitted.
Volume estimates (yield projections)	Estimates of yields from forest stands over time. Yield projections can be developed for stand volume, stand diameter or specific products, and for empirical (average stocking), normal (optimal stocking) or managed stands.
Watershed	An area drained by a stream or river. A large watershed may contain several smaller watersheds.
Wildlife tree	A standing live or dead tree with special characteristics that provide valuable habitat for conservation or enhancement of wildlife.
Woodlot licence	An agreement entered into under the *Forest Act*. It allows for small-scale forestry to be practised in a described area (Crown and private) on a sustained yield basis.

Appendix A

Description of Data Inputs and Assumptions for the Timber Supply Analysis

Introduction

In February of 1999 a data package for the Kamloops Timber Supply Area timber supply review was released for public review. As a result of public input a number of data and management assumptions have been revised. This appendix presents the revised data package used to produce the timber supply analysis.

The following tables and commentary outline the methods and inputs used to derive the timber harvesting land base, and to construct the timber supply model for the Kamloops TSA timber supply analysis. This information represents current forest management in the area. Current management is defined as the set of land-use decisions and forest and stand management practices that are currently implemented and enforced, or can be reasonably expected given current policies, laws and technologies. Hypothetical or possible future forest management objectives that are not currently implemented and enforced are not included in this appendix. The purpose of the timber supply review is to provide information on the effects of current management on both short- and long-term timber supply in each timber supply area in the province. Any changes in forest management objectives and practices, and any improvements to the data will be included in subsequent timber supply analyses.

A.1 Inventory Information

The inventory information used in this analysis combines the Ministry of Forests forest cover inventory for the Kamloops TSA (updated to 1996) with non-standard overlays added to provide information on forest conditions as well as the management considerations listed in Table A-1.

Table A-1. Forest inventory information

Data	Mapsheets / letter block	Year of re-inventory	Re-inventory photo age	Updated to[a]	Projection date
A. Kamloops Forest District					
FC1s					
– Forest cover – Operability – Biogeoclimatic classifications	**82L:** 041, 051, 052, 061, 062, 071, 072	1996	1995	1995	1997
– Ownership – Public sustained yield unit (PSYU) – Roads	**82L:** 081, 082, 083, 091, 092, 093	1993	1990	1994	1997
– District / TSA boundaries	**82M:** 001-003; 011-013, 021-023, 031, 032, 041	1993	1990	1994	1997
	82M: 033, 042, 043, 051	1996	1990	1995	1997
	82M: 052	1996	1990	1993	1997
	92I: 038-040, 044-047	1995	1991	1991	1997
	92I: 048-050, 052-060, 062-070, 072-080, 082-090, 092-100	1997	1995	1995	1997
	92P: 003, 004, 006-010, 016-020, 028-030, 038-040, 048-050, 058-060, 068, 069	1997	1995	1995	1997

(a) Given the vintage of the FIP updates when the analysis was initiated, disturbance information was obtained from licensees and used to over-ride the FIP information. This process was approved by Resources Inventory Branch.

(continued)

A.1 Inventory Information

Table A-1. Forest inventory information (concluded)

Data	Mapsheets / letter block	Year of re-inventory	Re-inventory photo age	Updated to[a]	Projection date
B. Clearwater Forest District					
FC1s – Forest cover	**82M:** 013, 022, 041, 042	1992	1990	1995	1997
– Operability – Ownership	**82M:** 023, 033-035, 043, 051, 052	1991	1990	1995	1997
– PSYU	**82M:** 024, 053	1991	1985 and 1990	1995	1997
– Roads	**82M:** 044, 045	1991	1986 and 1990	1995	1997
– District / TSA boundaries	**82M:** 054-056, 061-065, 072-075, 081-085, 092-095	1991	1985	1995	1997
	82M: 066, 076, 086, 096	1991	1985	1997	1997
	82M: 071	1991	1991	1996	1997
	82M: 091	1991	1991	1995	1997
	83D: 003-005, 013-15, 023-25, 033-35, 042-45	1990	1985	1995	1997
	83D: 006, 016, 026, 036, 052-55, 062, 063, 065	1990	1985	1997	1997
	83D: 017	1997	1991	1997	1997
	83D: 037, 046, 056, 064, 072	1996	1991	1997	1997
	92P: 050, 059, 060, 069, 070, 080, 088-90, 099, 100	1997	1995	1995	1997
	92P:	1991	1991	1992	1997

(a) Unless otherwise noted all maps are updated to December 1996 using the disturbance layer.

A.1 Inventory Information

Table A-2. Non-standard forest inventory information

Data	Source	Date created	Update	Scale
Disturbance layer	Ministry of Forests (MoF) Kamloops and MoF Clearwater	1997	Dec. 1996	1:20 000
Stream, lake and wetland reserve buffers	MoF Kamloops and MoF Clearwater	1996 1996	1997 1996	1:20 000
Biogeoclimatic ecosystem classifications – Clearwater Forest District	Research Branch	1990	1994	1:20 000
Community watersheds	MELP, Water Management Branch		1997	1:20 000
Visual quality objectives (VQOs)	MoF Kamloops MoF Clearwater	1995 1995	1997 1997	1:20 000
New protected areas	MoF / Ministry of Environment, Lands and Parks (MELP)	1995/1996/ 1998		1:20 000
LRMP critical deer management zones	MoF/MELP	1995	1997	1:50 000
LRMP caribou habitat resource management zones	MoF/MELP	1995	1997	1:50 000
Landscape unit boundaries and emphases	MoF/MELP	1996		1:20 000
Hudson's Bay Trail (designated portion)	MoF	1996		1:20 000
Tod Mountain development area	Sun Peaks Corp./MoF	1997	1997	1:20 000
New woodlots	MoF	1996/1997		1:20 000
Community watershed intakes	MELP, Water Management Branch		1997	1:20 000

Data source and comments:

Protected areas, landscape units, deer management areas, community watersheds, visually sensitive areas, caribou habitat RMZ, woodlots, stream, lake and wetland buffers, Tod Mountain development area and community watershed intakes used in this analysis do not appear on the current MoF inventory file. This information was merged with the standard inventory file to produce the inventory file to be used in this analysis. All this information resides in the Kamloops Forest District.

In 1996 and 1997 inventory audits were performed for the two districts comprising the Kamloops TSA, Clearwater and Kamloops Forest Districts respectively. The final reports presented the findings for the mature component (stand age $\geq$ 60 years) of the timber harvesting land base.

A.2 Zone and Analysis Unit Definition

Audit results for the Clearwater Forest District (47 samples) showed a difference of 13 cubic metres per hectare (- 4.3%) between the mean audit volume of 287 cubic metres per hectare and mean inventory volume of 300 cubic metres per hectare. This difference is not statistically significant, 19 times out of 20. The 95% confidence interval for the mean paired difference is - 47 to + 21 cubic metres per hectare.

Audit results for Kamloops Forest District (50 samples) showed a difference of four cubic metres per hectare (+ 2.2%) between the mean audit volume of 183 cubic metres per hectare and mean inventory volume of 179 cubic metres per hectare. This difference is also not statistically significant 19 times out of 20.

These audit results in the two forest districts indicate that the volume estimates used in TSR 1 were adequate and not a notable source of uncertainty.

The above results apply to the entire productive forest land base. The audit also supplied results that applied to the TSR 1 timber harvesting land base that were similar to the findings for the whole forest. However, the timber harvesting land base for the Kamloops TSA changed significantly since the last timber supply review and as such, the 1996/97 inventory audit results cannot be applied to the current timber harvesting land base. Nevertheless, the results for the entire mature forested area suggest the inventory represents timber volumes reasonably accurately.

A.2.1 Management zones, groups and objectives

To model current forest management, several resource emphasis groupings were defined for this analysis based on the following forest management objectives:

Table A-3. Group definition

Description	Inventory definition	Function
Landscape-level biodiversity	Non-standard mapped layer of 33 landscape units, interim LRMP biodiversity emphasis options are used.	Application of biodiversity targets using all Crown forested land at the landscape unit/ BEC zone-variant level.
Visually quality objectives	Non-standard mapped layer with data fields for VQO and visual absorption capacity (VAC).	Using all Crown forested land, each VQO/VAC combination is modelled independently for each visually sensitive polygon.
Community watersheds	Non-standard mapped layer. Seventeen MELP defined community watersheds.	Using all Crown forested land, each community watershed is modelled for hydrologic green-up.
Caribou habitat	Non-standard mapped layer. Kamloops LRMP approved early, late, and corridor habitat for caribou.	All Crown forested land within the Caribou habitat area.
Deer winter range	Non-standard mapped layer, Kamloops LRMP approved deer winter range.	Application of deer winter range cover across all Crown forested land identified.
Cutblock adjacency	Timber harvesting land base.	Application of adjacency criteria by landscape unit / BEC zone-variant within the timber harvesting land base.

A.2 Zone and Analysis Unit Definition

A.2.2 Analysis unit characteristics

An analysis unit represents a combination of stands dominated by specific tree species, a silvicultural regime, or a specific timber growing capacity — as indicated by the inventory type group (ITG) and site index in the forest inventory file.

Table A-4. shows the variables used to define each analysis unit. A separate timber volume was generated for each analysis unit (see Table A-22. for existing natural stands and Table A-23. for future managed stands). The analysis units are not management zone specific; that is an analysis unit can be in one or more of the management zones described in Section A.2.1, "Management zones, groups and objectives."

A.2 Zone and Analysis Unit Definition

Table A-4. Definition of analysis units

	Analysis unit (leading species)	Criteria			
		Inventory type groups	Biogeoclimatic unit (BGC)	Site index range (metres)	Age (years)
A. Conventional harvest land base					
1	Fir (Fd) / Dry belt – selection, all	1, 5, 6, 32	PPxh,IDFxh, IDFxw, IDFdk1, IDFdk3, BG	All	All
2	Fir (Fd) / Dry belt – small patch, all	1, 6, 7, 8, 32	IDFdk2, MSxk, except for FS, FH, FC, FB, or FPI type groups	All	All
3	Fir (Fd) / Wet belt, good/medium	1-8, 27, 32-34	All except those specified in analysis units 1 and 2	15.1+	< 141
4	Fir (Fd) / Wet belt, good/medium	1-8, 27, 32-34	All except those specified in analysis units 1 and 2	15.1+	≥ 141
5	Fir (Fd) / Wet belt, poor/low	1-8, 27, 32-34	All except those specified in analysis units 1 and 2	0-15.0	< 141
6	Fir (Fd) / Wet belt, poor/low	1-8, 27, 32-34	All except those specified in analysis units 1 and 2	0-15.0	≥ 141
7	Cedar (Cw), good/medium	9-11	All	17.1+	< 141
8	Cedar (Cw), poor/low	9-11	All	0-17.0	< 141
9	Hemlock (Hw), good/medium	12-17	All	16.1+	< 141
10	Hemlock (Hw), poor/low	12-17	All	0-16.0	< 141
11	Balsam (B), good/medium	18-20	All	13.1+	< 141
12	Balsam (B), good/medium	18-20	All	13.1+	≥ 141
13	Balsam (B), poor/low	18-20	All	0-13.0	< 141
14	Balsam (B), poor/low	18-20	All	0-13.0	≥ 141
15	Spruce (S), good/medium	21-26	All	14.1+	< 141

(continued)

A.2 Zone and Analysis Unit Definition

Table A-4. Definition of analysis units (concluded)

	Analysis unit (leading species)	Criteria: Inventory type groups	Biogeoclimatic unit (BGC)	Site index range (metres)	Age (years)
A. Conventional harvest land base (continued)					
16	Spruce (S), good/medium	21-26	All	14.1+	≥ 141
17	Spruce (S), poor/low	21-26	All	0-14.0	< 141
18	Spruce (S), poor/low	21-26	All	0-14.0	≥ 141
19	Pine (Pl), good/medium	28-31	All	14.1+	< 141
20	Pine (Pl), good/medium	28-31	All	14.1+	≥ 141
21	Pine (Pl), poor/low	28-31	All	0-14.0	< 141
22	Pine (Pl), poor/low	28-31	All	0-14.0	≥ 141
B. Cedar / hemlock partition					
32	Cedar (Cw), good/medium	9-11	All	17.1+	≥ 141
33	Cedar (Cw), poor/low	9-11	All	0-17.0	≥ 141
34	Hemlock (Hw), good/medium	12-17	All	16.1+	≥ 141
35	Hemlock (Hw), poor/low	12-17	All	0-16.0	≥ 141
C. Pulpwood agreement #16 land base					
23	Fir (Fd) / Dry	1, 5, 6, 32	PPxh, IDFxh, IDFxw, IDfdk1, IDFdk3,BG		> 80
24	Fir (Fd) / Dry	1, 6, 7, 8, 32	IDFdk2, MSxk, except for FS, FH, FC, FB or FPl type groups		> 80
25	Fir (Fd) / Wet	1-8, 27, 32-34	All except those specified in analysis units 23 and 24		> 80
26	Cedar (Cw)	9-11	All		80-140
27	Hemlock (Hw)	12-17	All		80-140
28	Balsam (B)	18-20	All		> 80
29	Spruce (S)	21-26	All		> 80
30	Pine	28-31	All		> 80
31	Deciduous	35-42	All		> 60

For analysis units 23-30 the criterion for minimum height is greater than or equal to 10.5 metres and for maximum height less than or equal to 20.0 metres.

A.3 Definition of the Timber Harvesting Land Base

Timber is harvested from only a portion of the total Kamloops TSA. One of the first steps in this timber supply analysis was to define the timber harvesting land base. This land base was derived by identifying types of land and forest where timber harvesting is not likely to occur under current management. The characteristics of each of these types are discussed below in the order in which they were excluded when defining the timber harvesting base. While these types of forest do not support timber harvesting, they do contribute to other objectives such as landscape-level biodiversity.

A.3.1 Total analysis area

Only area within the Kamloops TSA boundaries is included in the timber supply analysis.

All area on the FIP file coded 61, 62, 69, and 70 indicating Crown land in a use, recreation and enjoyment of public (UREP) area, forest management unit, miscellaneous reserve, or timber licence are included as areas managed by the B.C. Forest Service for contribution to timber supply. Other Crown lands are included for analysis purposes as they contribute to forest values such as biodiversity.

A.3.2 Non-forest

Type identity 6 areas (non-productive land) such as alpine, lakes, rocks, etc., and type identity 8 area (no typing available) are excluded from the land base considered for timber supply.

A.3.3 Non-commercial cover

Type identity 5 represents areas of non-commercial brush. These areas are considered to be unlikely sites for timber production and are excluded from the area considered available for timber harvesting.

A.3.4 Inoperable areas

Operability and inoperability codes are generally used to describe the presence or absence of physical barriers or limitations to harvesting, logging methods (e.g., cable), and the merchantability of stands. Operability lines for the Kamloops TSA were originally delineated by the Ministry of Forests, in consultation with licensees, in 1991. Inoperable areas are a 100% removal from the timber harvesting land base.

A.3.5 Environmentally sensitive areas

Forest lands that are environmentally sensitive and/or significantly valuable for other resources are identified in the forest inventory as environmentally sensitive areas (ESAs). The ESA system uses the following classification: soil (Es), forest regeneration problems (Ep), snow avalanche (Ea), recreation (Er), water (Eh) and wildlife (Ew). Two ESA categories are recognized: high (ESA1) and moderately sensitive (ESA2).

Two analysis strategies can be used to account for the reduced harvesting opportunity corresponding to environmental sensitivity: per cent area reductions; and the specific evaluation of individual ESA polygons for harvesting opportunity. Table A-5. shows the criteria used to account for environmentally sensitive areas where harvesting is not expected to occur.

A.3 Definition of the Timber Harvesting Land Base

Table A-5. Description of environmentally sensitive areas

ESA category	ESA description	Reduction per cent (%)
Es1	Soils — high	100
Er1	Recreation — high	100
Ep1	Regeneration — high	100
Ea1	Avalanche — high	100
Eh1	Water — high	100

Wildlife habitat requirements for deer and caribou are modelled using forest cover requirements rather than ESA exclusions.

All moderately sensitive areas (ESA2) are fully included in the timber harvesting land base.

Environmentally sensitive area reductions were established by the Ministry of Forests staff in collaboration with specialists from the Ministry of Environment, Lands and Parks. The percentages reflect site sensitivity to forest management, value for other resources and current management practices.

A.3.6 Non-merchantable stands

Problem forest types (PFT) are stands that are physically operable, but that are not currently utilized or have marginal merchantability. These types are wholly excluded from the timber harvesting land base. Table A-6. shows the characteristics and site productivity criteria used to define stands that are not currently being harvested.

A.3 Definition of the Timber Harvesting Land Base

Table A-6. Forest types not currently being harvested

Species	Characteristics	SI limit	Per cent (%) excluded
All	All mature and immature stands	≤ 8	100
All species except fir and deciduous	All stands classified as residual stocking class	≤ 15	100
All species except pine (Pl)	All species except pine outside PA 16 older than 80 years of age and less than 19.5 metres in height		100
Balsam and spruce	Balsam and spruce stands outside PA 16 older than 140 years of age, less than 28.5 metres in height, and with a crown closure of less than 36%		100
Pine (Pl)	Pine stands outside PA 16 older than 80 years of age, and less than 19 metres in height		100
Pine (Pl)	Pine stands outside PA 16 classified as 310 or 420	≤ 10	100
All species except pine (Pl)	All species except pine inside PA 16 older than 100 years of age and less than 10.5 metres in height.		100
Pine (Pl)	Pine stands inside PA 16 older than 80 years of age and less than 10.5 metres in height.		100
Deciduous	Deciduous stands outside PA 16		100
Deciduous	Deciduous stands inside PA 16 less than 61 years in age.		100

Pine 310 stands refer to pine (Pl) leading stands of age class 3 (41-60 years), height class 1 (0.1-10.4 metres) and stocking class 0 (immature). Pine 420 stands refer to pine (Pl) leading stands of age class 4 (61-80 years), height class 2 (10.5-19.4 metres) and stocking class 0 (immature).

A.3 Definition of the Timber Harvesting Land Base

A.3.7 Riparian reserve and management zones

Specific areas were removed from the productive forest land base to account for riparian reserve and management zones, as outlined in the following table.

Table A-7. Estimates for riparian reserve and management zones

Riparian classification	Reserve zone (RRZ) width (metres each side)	Management zone (RMZ) width (metres each side)	RMZ average basal area retention[a]	Combined riparian zone width (metres each side)
S1 streams	50	20	25	55
S2 streams	30	20	25	35
S3 streams	20	20	25	25
S4 streams — Kamloops (all) and Clearwater (fish bearing or community watershed)	10	20	12	12
S4 streams — Clearwater	0	30	12	4
S5 streams	0	30	12	4
S6 streams	0	20	3	0
All 'A' lakes	200	0	N/A	200
All other lakes — Kamloops	10	190 for 'B'-'E' lakes	0	10
All lakes > 1000 ha — Clearwater	0	200 for 'B'-'E' lakes	0	0
L1 lakes — Clearwater (> 5 ha and < 1000 ha)	10	190 for 'B'-'E' lakes	0	10
L3 lake — Clearwater (1-3 ha)	0	30	12	4
L3 lakes — Clearwater (3-5 ha)	0	200	0	0
W1/W5 wetlands (> 5 ha) all BEC zones	10	40	12	15
W2 wetlands (1 to 5 ha) PP, BG, IDFxh, xw, xm	10	20	12	12
W3/W4 wetlands (0 to 1 ha) PP, BG, IDFxh, xw, xm	0	30	12	3
W3/W4 wetlands (1 to 5 ha) all BEC zones	0	30	12	3

(a) Retention values are 50% of maximum listed in the *FPC Riparian Management Area Guidebook.*

A.3 Definition of the Timber Harvesting Land Base

Riparian reserve areas were specifically removed from the productive forest land base through a buffering and overlay process in a geographic information system (GIS). Riparian zone widths accounted for both the reserve zone and a portion of the management zone according to the recommended maximum basal area retention in each management zone type (i.e., a management zone of 20 metres with recommended 50% basal area retention was modelled as a 10 metre reserve zone).

In addition to the land base removals for riparian reserve and management zones, a 200-metre management zone buffer was applied to all B, C, D and E class lakes (200 metres including the reserve zone within). Visual quality objectives of retention and partial retention were assigned to buffers around each B and C class lake, respectively. A VQO of modification was assigned to lake class D and E buffers.

A.3.8 Exclusion of specific, geographically defined areas

Table A-8. identifies specific areas that were excluded from the timber harvesting land base.

Table A-8. Exclusion of specific, geographically defined areas

Location descriptors	Excluded area (hectares)	Reason for exclusion
Hudson's Bay Trail (designated portion)	200 metre buffer (1 hectare/ 50 m. trail)	Order-in-Council
Tod Mountain / Sun Peaks	383	Alienation for resort development
Water intakes for community watersheds (20 intakes)	1.57 hectares / intake	*Timber Harvesting Practices Regulation Section 17.1*

A 200-metre buffer was applied to the Hudson's Bay Recreation Trail, and the area excluded from the timber harvesting land base. The area removed for Tod Mountain / Sun Peaks reflects that the area has been alienated from the provincial forest land base for further resort development. The water intakes were identified from the Ministry of Environment, Lands and Parks community watershed maps, and a 100-metre upland buffer was applied.

Archaeological overview and cultural heritage value inventories for the entire Kamloops TSA are yet to be completed or are not comprehensive. The impacts of measures required to protect known sites remain unquantified at this time.

A.3.9 Current roads, trails and landings

Separate estimates were made to reflect the loss in productive forest land due to existing and future roads, trails and landings (RTL). Existing RTL estimates were applied as reductions to the current productive forest considered available for harvesting, and future RTL reductions were applied after stands were projected for harvest for the first time in the simulation model. Estimates were applied as the percentages of area to be removed from specified age classes and account only for the area that will be permanently removed from the timber harvesting land base.

The amount of area in existing roads was determined by applying a 13-metre or 10-metre buffer to all existing primary and secondary roads on the inventory file, and directly removing this area from the productive forest land base.

A.3 Definition of the Timber Harvesting Land Base

Table A-9. Estimates for existing and future roads, trails and landings

Location	Age (years)	Road width (metres)	Reduction area (hectares) or per cent (%)
Existing primary roads	All	13	
Existing secondary roads	All	10	
Estimate for existing landings and on-block disturbance	< 31		4.9%
Future roads, landings and on-block disturbance	> 30		6.5%

Based on 1986-1992 site degradation samples, which estimated the area in existing landings and trails too small to be captured in the inventory, a 4.9% area reduction was applied to all areas younger than 31 years (assumed to have a harvesting history).

The estimate of future roads, landings and on-block disturbance was based on estimated averages of 6.2% and 6.9% for the Clearwater and Kamloops Forest Districts, respectively. The Clearwater Forest District used average in-block disturbances over the last three years from silvicultural records, while the Kamloops Forest District based their estimates from permanent access targets documented in silvicultural prescriptions from June 1996 to June 1997.

A.3.10 Wildlife trees (WT) and wildlife tree patches (WTP)

Three methods are used in the Kamloops TSA to maintain stand structure over time: single tree reserves, wildlife tree patches within cutblocks (WTPs) and wildlife tree patches adjacent to cutblocks (WTOs). Single tree reserves are unlikely to provide harvestable volumes in the future, and are therefore modelled as volume reductions. WTPs are generally less than two hectares in size, and are also unlikely to be harvested in the future, and are modelled as volume reductions. WTOs are generally greater than two hectares in size, and the total area associated with WTOs is considered to contribute towards seral stage requirements (i.e., is included in the area retained to meet landscape-level biodiversity objectives), and was not modelled as a wildlife tree patch constraint. Operationally, these areas may be incorporated into old-growth management areas (OGMA).

Table A-10. Reductions to reflect volume retention in cutblocks for wildlife tree patches

Wildlife tree patch type	Persistence	Anticipated harvest activity	Per cent (%) of annual harvested volumes	Area (hectares) per year
Single tree	Permanent	No	1.07	N/A
WTP	Permanent	No	1.05	N/A
Total			2.12	

Estimates of volumes retained in single tree reserves and wildlife tree patches were derived for the Kamloops Forest District. All information was gathered for the period October 1996 to October 1997.

A.3 Definition of the Timber Harvesting Land Base

Information on volumes retained in single trees was obtained from waste and residue surveys completed for 253 blocks (4153 hectares). A total volume of 13 257 cubic metres was left behind in single tree reserves, representing an average of 1.38% of harvested volumes for October 1996 to October 1997.

Volumes retained in wildlife tree patches were tracked by licensees and noted in silviculture prescriptions. Wildlife tree patches located within riparian management areas were not included in these volume estimates, as these areas were already removed from the timber harvesting land base through riparian reserve and management zones. Total volumes per year were recorded and a per cent of annual harvest volumes derived. It was determined that 10 245 cubic metres was left behind in wildlife tree patches, representing an average of 0.86% of harvested volumes for that year.

For the Clearwater Forest District estimates were derived from reviewing the Kamloops Forest District results and providing professional judgment. Based on mainly having wet-belt timber types and very little dry-belt timber types, 50% of the single tree and 150% of the wildlife tree patch numbers for the Kamloops Forest District were used. This represents 0.69% for single tree reserves and 1.29% for wildlife tree patches. The values for both forest districts were area-weighted and summed, as outlined in Table A-10.

A.3.11 Timber licence reversions

Timber licences (TLs) are old tenure arrangements that give a licensee exclusive rights to harvest merchantable timber within the licence area, and do not contribute to the TSA allowable cut. Once these areas have been harvested, regenerated and attain free-growing status, the timber licence area reverts to the Kamloops TSA. Accordingly, these areas were included in the timber harvesting land base after the first expected harvest, and contribute to medium- to long-term timber supply in the TSA.

Timber licence areas need to be accounted for from the time stands have been, or are estimated to be harvested. Time of harvest is used as the reference point so that impact of these harvests on forest cover requirements is given full consideration in the timber supply analysis. In some cases stands that have been harvested and legally reverted have not had the necessary ownership change on the inventory file (e.g., change from 70 to 62).

Table A-11. Timber licence reversion schedule

Area of timber licence (TL) harvested (hectares per decade)				
1st decade	2nd decade	3rd decade	4th decade	5th decade
2 117	2 024	2 244	1 948	1 523

It is estimated that approximately 200 hectares of timber licence area is harvested each year, and subsequently reverts to Crown management. Approximately 13 600 hectares of timber licence area will revert to the timber harvesting land base. About 3760 hectares have already reverted but have not yet been accounted for in the inventory file. This was accounted for in the analysis.

A.3 Definition of the Timber Harvesting Land Base

A.3.12 Not satisfactorily restocked (NSR) areas

Land classified in the Kamloops TSA inventory file as type identity 4 or 9 was generally included in the timber harvesting land base. These type identities indicate not satisfactorily restocked (NSR) land base. This section identifies the current total area of NSR in the timber harvesting land base, and the estimated rate at which the NSR area will be restocked. Figures provided in the following table (from the forest district silviculture records) have been prorated to match the inventory file NSR total area.

Table A-12. Not satisfactorily restocked (NSR) areas

Forest district	Backlog NSR area (hectares)	Current NSR area (hectares)
Clearwater Forest District	2 129	5 400
Kamloops Forest District	1 000	6 000
Total	3 129	11 400

The data for backlog NSR was derived from the Integrated Silviculture Information System (ISIS) and the Major Licensee Silviculture Information System (MLSIS). Current NSR reflects roughly 1.5 years of harvest area which has not yet been planted. Backlog NSR target date to be restocked is the year 2002.

A.4 Forest Management Assumptions

A.4.1 Utilization levels

The utilization level defines the maximum stump height, minimum top diameter inside bark (dib) and minimum diameter at breast height (dbh) (1.3 metres) by species and was used in the analysis to calculate merchantable volume.

Table A-13. reflects current regional standards, licence requirements and current performance.

Table A-13. Utilization levels

Analysis unit	Utilization		
	Minimum dbh (cm)	Maximum stump height (cm)	Minimum top dib (cm)
Lodgepole pine	12.5	30	10
Cedar > 140 years	17.5	30	15
All other coniferous species	17.5	30	10
PA 16 coniferous	7.5	30	8
PA 16 deciduous	12.5	30	10

The yield curves for PA 16 did not reflect the utilization standards in the table. Information on the impacts will be presented to the chief forester for his consideration in the AAC determination.

A.4.2 Volume exclusions for mixed species stands

When a portion of a stand is not normally utilized and is therefore not harvested, the unharvested portion is excluded from the stand volume estimate. In the Kamloops TSA, deciduous species in predominantly coniferous stands outside of PA 16 are not harvested, as reflected in Table A-14. Leading-deciduous stands outside of PA 16 were excluded from the timber harvesting land base (see Table A-6., "Forest types not currently being harvested").

Table A-14. Volume exclusions for mixed species types

Species	Volume exclusion (%)
All deciduous volumes in all analysis units except PA 16 types	100

A.4.3 Minimum harvestable age derivation

Minimum harvestable age defines the earliest age at which the stand may be harvested. Harvesting may occur in stands at the minimum requirements in order to meet forest-level objectives (e.g., maintaining overall harvest levels for a short period of time or avoiding large inter-decadal changes in harvest levels). Most existing stands will not be harvested until well past the minimum timber production ages because other resource values take precedence (e.g., requirements for the retention of older forest). Minimum harvestable ages for future managed stands were determined based on the culmination of mean annual increment. Once stands reach 90% of the maximum mean annual increment age they are assumed to be available for timber harvest.

A.4 Forest Management Assumptions

Table A-15. Minimum harvestable ages

Analysis unit	Species	Minimum harvestable age — existing (years)	Minimum harvestable age — future (years)
Existing – AU 1 Future – AU 51	Dry-belt Douglas-fir selection	100	100
Existing – AU 2 Future – AU 52	Dry-belt Douglas-fir small patch management	80	90
Existing – AU 3 Future – AU 53	Wet-belt Douglas-fir good / medium, < 141	80	80
Existing – AU 4 Future – AU 54	Wet-belt Douglas-fir good / medium, > 140	80	80
Existing – AU 5 Future – AU 55	Wet-belt Douglas-fir poor, < 141	100	100
Existing – AU 6 Future – AU 56	Wet-belt Douglas-fir poor, > 140	100	100
Existing – AU 7 Future – AU 57	Cedar, good / medium, < 141	100	80
Existing – AU 8 Future – AU 58	Cedar, poor, < 141	100	100
Existing – AU 9 Future – AU 59	Hemlock, good / medium, < 141	100	80
Existing – AU 10 Future – AU 60	Hemlock, poor, < 141	100	100
Existing – AU 11 Future – AU 61	Balsam, good / medium, < 141	100	90
Existing – AU 12 Future – AU 62	Balsam, poor, < 141	100	120
Existing – AU 13 Future – AU 63	Balsam, good / medium, > 140	100	100
Existing – AU 14 Future – AU 64	Balsam, poor, > 140	100	130
Existing – AU 15 Future – AU 65	Spruce, good / medium, < 141	100	80
Existing – AU 16 Future – AU 66	Spruce, poor, < 141	100	110

(continued)

A.4 Forest Management Assumptions

Table A-15. Minimum harvestable ages (concluded)

Analysis unit	Species	Minimum harvestable age — existing (years)	Minimum harvestable age — future (years)
Existing – AU 17 Future – AU 67	Spruce, good / medium, >140	100	80
Existing – AU 18 Future – AU 68	Spruce, poor, >140	100	130
Existing – AU 19 Future – AU 69	Lodgepole pine, good / medium, <141	80	80
Existing – AU 20 Future – AU 70	Lodgepole pine, poor, <141	80	80
Existing – AU 21 Future – AU 71	Lodgepole pine, good / medium, >140	80	80
Existing – AU 22 Future – AU 72	Lodgepole pine, poor, >140	80	80
Existing – AU 23 Future – AU 73	Pulpwood Agreement 16 Douglas-fir (dry belt), Selection	100	100
Existing – AU 24 Future – AU 74	PA 16 Douglas-fir (dry belt), Small Patch	80	130
Existing – AU 25 Future – AU 75	PA 16 Douglas-fir (wet belt)	80	110
Existing – AU 26 Future – AU 76	PA 16 Cedar	80	120
Existing – AU 28 Future – AU 78	PA 16 Balsam	80	120
Existing – AU 29 Future – AU 79	PA 16 Spruce	80	120
Existing – AU 30 Future – AU 80	PA 16 Lodgepole pine	80	80
Existing – AU 31 Future – AU 81	PA 16 Deciduous	60	80
Existing – AU 32 Future – AU 82	Cedar, good / medium, >140	140	80
Existing – AU 33 Future – AU 83	Cedar, poor, >140	140	110
Existing – AU 34 Future – AU 84	Hemlock, good / medium, >140	140	80
Existing – AU 35 Future – AU 85	Hemlock, poor, >140	140	110

A.4 Forest Management Assumptions

A.4.4 Unsalvaged losses

Table A-16. shows the estimated average annual unsalvaged volume loss to catastrophic events such as insect epidemics, fires, wind damage or other agents over the long term on the timber harvesting land base. The unsalvaged loss column only reflects those areas in which the volume will not be recovered or salvaged.

Table A-16. Unsalvaged losses

Cause of loss	Annual unsalvaged loss (m^3/year)
Bark beetles	3 900
Defoliators	36 130
Wind damage	9 250
Fire	12 210
Miscellaneous	1 100
Total	62 590

For unsalvaged bark beetle infestations (mountain pine beetle, Douglas-fir beetle and spruce beetle), all salvage cutting permits from the last 5 years were compiled and mapped. The volume unsalvaged was estimated using bark beetle probe data or 35 mm oblique aerial photographs.

Approximately 95% of the unsalvaged loss to defoliators results from hemlock looper damage to old hemlock stands in the Clearwater Forest District. The remaining 5% is unaccounted western spruce budworm mortality not already captured in the inventory yield curves.

Any major blowdown events (greater than 200 cubic metres) in unharvested stands in the last five years were identified by the Ministry of Forests staff. If the blowdown was in the timber harvesting land base and was not harvested, it is considered an unsalvaged loss. The blowdown along cutblock edges which is not salvaged is also an unsalvaged loss. Based on the experience of the Ministry of Forests staff, a value of 50 cubic metres/block is attributed to edge blowdown.

Unsalvaged losses due to fire are based on 5 years of district fire reports and detailed maps of fire killed area and salvaged cutblocks. By subtracting the total fire area from salvaged areas, reserved areas (i.e., riparian zones) and inoperable areas, the number of unsalvaged areas was estimated. A volume was estimated by multiplying the unsalvaged hectares by the average volume per hectare extrapolated from scale returns and total area logged.

Western balsam bark beetle mortality is assumed to be accounted for in the inventory yield curves.

Miscellaneous losses relate to flood damage, landslide areas and other minor factors.

A.4 Forest Management Assumptions

A.4.5 Basic silviculture and regeneration assumptions

The silviculture program reflects the mix of treatments expected to be carried out in the Kamloops TSA. This level of activity assumes basic silviculture on all sites. Table A-17. shows the proportion of each analysis unit to be treated under each silviculture regime and the expected average regeneration delay.

Recent plantations and future stands are grown on managed stand yield tables (MSYTs) produced using the B.C. Forest Service table interpolation program for stand yields (TIPSY) growth and yield model. A MSYT may be built from a number of tables if more than one regeneration method is used within an analysis unit. When this is the case, tables have been produced for the different regeneration methods (each method x species combination) are then aggregated into one table.

Table A-17. Regeneration assumptions by analysis unit

				Method			Density	
Analysis unit	**Leading species**	**Site class / age**	**Regen delay (years)**	**Type**	**%**	**Species**	**Spp. %**	**Stems / hectare**
1	Fir / dry	N/A	N/A	Selection – natural	All	N/A	N/A	N/A
2	Fir / dry	N/A	2	Plant	100	Fd	70	1200
						Pl	30	1200
3	Fir / wet	G/M < 141	2	Plant	100	Fd	60	1400
						Pl	25	1600
						Sx	15	1400
4	Fir / wet	G/M ≥ 141	2	Plant	100	Fd	60	1400
						Pl	25	1600
						Sx	15	1400
5	Fir / wet	P/L <141	2	Plant	100	Fd	25	1300
						Pl	65	1500
						Sx	10	1300
6	Fir / wet	P/L ≥ 141	2	Plant	100	Fd	25	1300
						Pl	65	1500
						Sx	10	1300
7	Cedar	G/M < 141	2	Plant	100	Fd	15	1400
						Pl	10	1600
						Sx	45	1400
						Cw	20	1300
						Hw	10	1300
8	Cedar	P/L < 141	2	Plant	100	Fd	30	1300
						Pl	10	1500
						Sx	30	1300
						Cw	20	1300
						Hw	10	1300

(continued)

A.4 Forest Management Assumptions

Table A-17. Regeneration assumptions by analysis unit

Analysis unit	Leading species	Site class / age	Regen delay (years)	Method		Density		
				Type	%	Species	Spp. %	Stems / hectare
9	Hemlock	G/M <141	2	Plant	100	Fd	30	1400
						Pl	10	1600
						Sx	40	1400
						Cw	10	1300
						Hw	10	1300
10	Hemlock	P/L < 141	2	Plant	100	Fd	10	1400
						Pl	25	1500
						Sx	40	1300
						Cw	15	1300
						Hw	10	1300
11	Balsam	G/M <141	3	Plant	100	Se	80	1400
						Bl	20	1400
12	Balsam	G/M ≥ 141	3	Plant	100	Se	80	1400
						Bl	20	1400
13	Balsam	P/L < 141	3	Plant	100	Se	60	1300
						Bl	25	1300
						Pl	15	1500
14	Balsam	P/L ≥ 141	3	Plant	100	Se	60	1300
						Bl	25	1300
						Pl	15	1500
15	Spruce	G/M < 141	3	Plant	100	Sx	60	1400
						Pl	25	1600
						Bl	15	1400
16	Spruce	G/M ≥ 141	3	Plant	100	Sx	60	1400
						Pl	25	1600
						Bl	15	1400
17	Spruce	P/L <141	2	Plant	100	Sx	70	1300
						Pl	10	1500
						Bl	20	1300
18	Spruce	P/L ≥ 141	2	Plant	100	Sx	70	1300
						Pl	10	1500
						Bl	20	1300
19	Pine	G/M < 141	2	Plant	100	Fd	10	1400
						Sx	10	1400
						Pl	80	1600
20	Pine	G/M ≥ 141	2	Plant	100	Fd	10	1400
						Sx	10	1400
						Pl	80	1600

(continued)

A.4 Forest Management Assumptions

Table A-17. Regeneration assumptions by analysis unit

Analysis unit	Leading species	Site class / age	Regen delay (years)	Method		Density		
				Type	%	Species	Spp. %	Stems / hectare
21	Pine	P/L < 141	2	Plant	100	Sx	10	1300
						Pl	90	1500
22	Pine	P/L ≥ 141	3	Plant	100	Sx	10	1300
						Pl	90	1500
23	Fir / dry	PA 16	N/A	Selection – natural	All	N/A	N/A	N/A
24	Fir / dry	PA 16	2	Plant	100	Fd	70	1200
						Pl	30	
25	Fir / wet	PA 16	2	Plant	100	Fd	25	1300
						Pl	65	1500
						Sx	10	1300
26	Cedar	PA 16	2	Plant	100	Fd	30	1300
						Pl	10	1500
						Sx	30	1300
						Cw	20	1300
						Hw	10	1300
27	Hemlock	PA 16	2	Plant	100	Fd	10	1400
						Pl	25	1500
						Sx	40	1300
						Cw	15	1300
						Hw	10	1300
28	Balsam	PA 16	3	Plant	100	Se	60	1300
						Bl	25	1300
						Pl	15	1500
29	Spruce	PA 16	2	Plant	100	Sx	70	1300
						Bl	10	1500
						Pl	20	1300
30	Pine	PA 16	2	Plant	100	Sx	10	1300
						Pl	90	1500
31	Deciduous	PA 16	2	Natural	All	Decid	100	2500

(continued)

A.4 Forest Management Assumptions

Table A-17. Regeneration assumptions by analysis unit (concluded)

Analysis unit	Leading species	Site class / age	Regen delay (years)	Method		Density		
				Type	%	Species	Spp. %	Stems / hectare
32	Cedar	G/M ≥ 141	2	Plant	100	Fd	15	1400
						Pl	10	1600
						Sx	45	1400
						Cw	20	1300
						Hw	10	1300
33	Cedar	P/L ≥ 141	2	Plant	100	Fd	30	1300
						Pl	10	1500
						Sx	30	1300
						Cw	20	1300
						Hw	10	1300
34	Hemlock	G/M ≥ 141	2	Plant	100	Fd	30	1400
						Pl	10	1600
						Sx	40	1400
						Cw	10	1300
						Hw	10	1300
35	Hemlock	P/L ≥ 141	2	Plant	100	Fd	10	1400
						Pl	25	1500
						Sx	40	1300
						Cw	15	1300
						Hw	10	1300

All values in Table A-17. are based on current performance as estimated by the Kamloops and Clearwater Forest District staff. Age of planting stock is approximately one year on average, and has been subtracted from the regen delay listed in the table. Species percentages are expected at rotation. Operational adjustment factors (OAF) of 15% (OAF1) and 5% (OAF2) have been applied to all managed stand yield curves to account for natural spatial patchiness and decay, waste and breakage, respectively.

It is assumed that selection harvest systems remove 40% of the existing volume on the first pass. Additional harvests in selection stands can begin after 30 years, and will remove 30% of the original standing volume.

A.4 Forest Management Assumptions

A.4.6 Immature plantation history

For this analysis, it was assumed that all stands established since 1974 (< 25 years old) have a history of density control and stand tending, and are considered managed stands. These stands were assigned to a managed stand yield curve.

A.4.7 Harvest scheduling priorities

Generally, older available stands are favoured for harvesting when all other objectives have been met. Therefore, a relative oldest first harvest queue rule was used in the model, whereby stands furthest from their respective minimum harvestable ages are given highest priority for harvest.

Table A-18. reflects average per cent harvested by species in the Kamloops TSA, over the last 5 years. The figures in the table are historic volume-based harvest profiles and are presented for information only.

Table A-18. Harvest scheduling history

Analysis units	Species	Per cent (%) of total harvest by period Decade 1
11-14, 28	Balsam	11
7, 8, 26, 32, 33	Cedar	6
1-6, 25	Douglas-fir	22
9, 10, 27, 34, 35	Hemlock	4
19-22, 30	Lodgepole pine	32
15-18, 29	Spruce	25

A.4 Forest Management Assumptions

A.4.8 Forest cover requirements — resource management zones

The following forest cover requirements are applied to the identified resource emphasis group or zone. The final column of the table shows the land base to which the requirement applies. All forest within that land base, regardless of whether or not it is in the timber harvesting land base, can contribute to the required forest cover.

Table A-19. Forest cover requirements

Management zone	Forest cover objectives		Minimum older age (years)	Minimum area of older age retained (%)	Land base constraints apply to
	Green-up height (metres)	Green-up maximum allowable disturbance (%)			
Community watersheds	6.6 metres (25 years)	25.2			Crown forested land base within each watershed.
East Blackpool watershed	6.6 metres (25 years)	25.2			Crown forested land base within the watershed.
Caribou late winter habitat			140	33	Crown forested land base within identified habitat.
Caribou early winter (transitional)			140	20	Crown forested land base within identified habitat.
Caribou corridors	3 metres (16 years)	20	75 (20 metres)	30	Crown forested land base within identified corridors.
Critical deer winter range	3 metres (16 years)	20	75 (20 metres)	25	Crown forested land base.
Visually sensitive	Refer to Table A-20.				Crown forested land base.
Standard management	3 metres (16 years)	33			Timber harvesting land base within each BEC variant, by landscape unit.

An equivalent clearcut area (ECA) of 20% of the gross land base applies to the upper 60% of all community watersheds. The upper 60% (snowpack area) is considered hydrologically recovered upon reaching 9 metres in height. The lower 40% of the watershed is subject to standard management. In each community watershed, on average, no more than 25.2% of the gross area can be less than 6.6 metres in height. The District Manager in the Clearwater Forest District has indicated that the East Blackpool watershed will be managed per community watershed requirements.

A.4 Forest Management Assumptions

Caribou late winter habitat is managed per the Kamloops LRMP to ensure that at all times one-third of the gross forested area in identified habitat areas is older than 140 years, to maintain lichen production. In addition, no more than one-third of the timber harvesting land base in the habitat areas can be less than 3 metres in height, consistent with the standard integrated resource management (IRM) zone.

In the caribou early winter (transitional) habitat type, at least 20% of the gross forested area must be older than 140 years in age, and no more than 33% of the timber harvesting land base can be less than 3 metres in height. Within the caribou research area in the North Thompson habitat zone, a moratorium area is in effect for the next 10 years, after which this area is modelled as late winter habitat.

Within caribou movement corridors, at least 30% of the gross forested area must be covered by stands greater than 20 metres in height, in order to provide sufficient thermal cover, and no more than 20% of the gross forested area may contain stands less than 3 metres in height.

The critical deer winter range area includes the Skull Habitat RMZ, and is managed to ensure sufficient thermal cover is maintained. At least 25% of the gross forested area must be greater than 20 metres in height, and no more than 20% of the gross forested area can be less than 3 metres in height.

In the standard management zone, harvesting is assumed to follow a 3-pass sequence, requiring that no more than 33% of the timber harvesting land base be less than three metres in height within each landscape unit, BEC variant combination.

Table A-20. Forest cover requirements for visually sensitive area

	Low VAC			Intermediate VAC			High VAC		
Visual quality objective	**Green-up height (m)**	**% removal range**	**% removal mid-point**	**Green-up height (m)**	**% removal range**	**% removal mid-point**	**Green-up height (m)**	**% removal range**	**% removal mid-point**
Preservation	3	5-7	6	3	6-9	7.5	3	8-10	9
Retention	5	5-10	7.5	4	10-15	12.5	3	15-20	17.5
Partial retention	5	10-15	12.5	4	15-20	17.5	3	20-25	22.5
Modification	5	15-20	17.5	4	20-25	22.5	3	25-30	27.5

Constraints for visually sensitive areas were determined for each visually sensitive polygon, based on the *Kamloops Land and Resource Management Plan VQO Guidelines*, and current management practices. The range of maximum per cent area removal (maximum per cent area below visual green-up height) was determined based on the existing visual absorption capacity and the visual quality objective for each polygon. The mid-point of this per cent removal range was determined for each VQO polygon, and each polygon was modelled separately in the analysis.

A.4 Forest Management Assumptions

The Kamloops LRMP requires that biodiversity be managed at a landscape scale. Table A-21. summarizes the percentage of old forest required for each NDT and biogeoclimatic zone modelled in this analysis. Requirements for retention of mature forest and constraints on early seral forest were considered in the sensitivity analysis, and were based on the *Biodiversity Guidebook*.

Table A-21. Old-seral requirements by landscape unit and natural disturbance type (NDT)

		Old seral stage % area retention by minimum age			
NDT	**Biogeoclimatic unit**	**Minimum age (years)**	**Low emphasis**	**Intermediate emphasis**	**High emphasis**
1	ICH	250	13	13	19
1	ESSF	250	19	19	28
2	ICH	140	9	9	13
3	ESSF	140	14	14	21
3	ICH	140	14	14	21
3	MS	140	14	14	21
3	SBS	140	11	11	16
3	SBPS	140	7	7	10
4	IDF	250	13	13	19
4	PP	250	13	13	19

In the analysis, percentage requirements for old-forest retention were based on interim biodiversity emphasis options (BEOs) assigned in the Kamloops LRMP for each landscape unit in the Kamloops TSA.

A.5 Volume Estimates for Existing Stands

The variable density yield projection (VDYP) model, version 6.4a developed and supported by the B.C. Ministry of Forests, Resources Inventory Branch, was used to estimate timber volumes for existing natural stands. Table A-22. shows the volume estimates by analysis unit for existing natural stands.

For selection analysis units (1 and 23), the volumes shown represent 40% of the total average existing volume to be harvested on the first pass. (Additional harvests in selection stands can begin 30 years after initial harvest, and will remove 30% of the original standing volume, which is reflected in the managed stand yields in Table A-23.).

Table A-22. Timber volume tables for existing natural stands (cubic metres)

Table	1	2	3	4	5	6	7
Age	Fir Dry Selection	Fir Dry Small Patch	Fir Wet ≤ 140 years G/M	Fir Wet > 140 years G/M, 8+	Fir Wet ≤ 140 years P/L	Fir Wet > 140 years P/L	Cedar ≤ 140 years G/M
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	0.00	0.00	0.01	0.00	0.00	0.00	0.02
30	0.04	0.36	5.71	0.71	0.02	0.04	7.83
40	0.92	7.02	35.38	16.79	0.35	0.45	55.02
50	5.11	24.03	74.44	50.86	10.65	12.21	99.56
60	12.07	45.32	113.01	86.43	29.21	35.38	141.08
70	19.74	67.30	150.04	120.68	48.61	59.68	178.46
80	27.41	88.91	185.02	153.28	67.60	83.11	212.82
90	34.92	109.96	217.54	183.53	85.85	105.26	238.21
100	42.20	130.27	247.38	211.81	103.26	126.23	258.81
110	49.22	149.72	274.43	238.19	119.80	146.07	275.68
120	55.46	166.77	297.82	261.12	134.41	163.64	288.47
130	61.29	182.37	319.52	283.27	147.91	180.43	307.79
140	66.52	196.30	338.19	303.01	159.70	195.29	325.96
150	71.22	208.84	354.88	320.78	170.18	208.59	342.92
160	75.38	219.94	369.56	336.65	179.12	220.26	358.50
170	79.04	229.80	382.60	350.84	186.83	230.41	373.05
180	82.70	239.67	394.62	364.68	194.42	240.38	387.09
190	86.16	248.97	405.38	377.57	201.44	249.62	400.43
200	89.54	257.92	416.14	390.14	208.47	258.90	413.38
210	92.75	266.40	426.35	402.11	215.22	267.84	425.85
220	95.81	274.48	436.01	413.49	221.66	276.42	440.33
230	98.72	282.16	445.17	424.28	227.76	284.67	454.43
240	101.49	289.47	453.87	434.55	233.56	292.58	468.18
250	104.12	296.43	462.11	444.34	239.08	300.14	481.54
260	104.21	296.62	462.63	445.44	239.60	301.11	482.31
270	104.28	296.80	463.07	446.46	240.05	301.98	483.00
280	104.35	296.97	463.44	447.39	240.45	302.78	483.63
290	104.40	297.12	463.73	448.25	240.79	303.51	484.19
300	104.44	297.26	463.96	449.04	241.08	304.16	484.72
310	104.48	297.38	464.12	449.75	241.32	304.74	485.19
320	104.50	297.49	464.22	450.41	241.52	305.27	485.63
330	104.50	297.58	464.25	451.01	241.68	305.72	486.03
340	104.50	297.66	464.22	451.55	241.79	306.13	486.42
350	104.50	297.73	464.11	452.02	241.86	306.47	486.76

(continued)

A.5 Volume Estimates for Existing Stands

Table A-22. Timber volume tables for existing natural stands (cubic metres)

Table	8	9	10	11	12	13	14
Age	Cedar ≤ 140 years P/L	Hemlock ≤ 140 years G/M	Hemlock ≤ 140 years P/L	Balsam ≤ 140 years G/M	Balsam > 140 years G/M,8+	Balsam ≤ 140 years P/L	Balsam > 140 years P/L, 8+
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	0.00	0.03	0.19	0.00	0.00	0.00	0.00
30	0.35	6.63	0.07	3.03	0.83	0.00	0.00
40	14.87	61.63	5.33	25.46	14.08	1.47	0.71
50	44.83	129.60	36.32	60.90	41.75	13.00	8.86
60	74.76	188.79	80.45	96.49	74.75	32.12	25.22
70	102.16	239.98	125.65	132.08	108.36	57.80	50.29
80	127.47	284.15	166.80	161.82	135.89	78.66	71.49
90	147.40	316.77	200.24	187.36	159.68	97.13	90.35
100	164.30	342.55	228.22	210.20	181.03	113.81	107.37
110	178.73	363.05	251.68	230.79	200.32	128.94	122.83
120	190.44	378.74	270.88	249.28	217.7	142.62	136.88
130	205.73	399.66	293.17	269.74	236.85	157.53	151.92
140	220.01	417.90	312.89	289.06	255.19	171.90	166.40
150	233.34	433.94	330.65	307.15	272.53	185.56	180.18
160	245.62	447.81	346.35	324.08	288.91	198.57	193.32
170	256.98	459.78	360.25	340.00	304.42	210.98	205.87
180	268.12	470.48	372.73	355.02	319.16	222.83	217.85
190	278.72	479.94	383.67	369.18	333.18	234.17	229.32
200	289.08	489.18	394.87	382.89	346.69	245.13	240.38
210	299.06	497.65	405.46	395.96	359.66	255.66	251.02
220	310.57	505.33	415.54	408.43	372.09	265.82	261.26
230	322.00	512.42	424.91	420.37	384.01	275.59	271.14
240	333.23	518.99	433.54	431.83	395.45	285.02	280.68
250	344.28	525.16	441.57	442.79	406.43	294.14	289.89
260	345.37	527.96	445.74	444.69	408.40	295.68	291.88
270	346.30	530.53	449.00	446.45	410.22	297.1	293.75
280	347.15	532.89	452.67	448.08	411.93	298.44	295.51
290	347.94	535.09	455.68	449.60	413.53	299.69	297.16
300	348.68	537.14	458.43	451.02	415.01	300.86	298.71
310	349.39	539.03	461.00	452.34	416.40	301.96	300.17
320	350.02	540.79	463.39	453.56	417.69	302.99	301.55
330	350.60	542.43	465.66	454.70	418.91	303.95	302.85
340	351.13	544.00	467.78	455.76	420.04	304.86	304.07
350	351.62	545.44	469.78	456.73	421.09	305.70	305.22

(continued)

A.5 Volume Estimates for Existing Stands

Table A-22. Timber volume tables for existing natural stands (cubic metres)

Table	15	16	17	18	19	20	21	22
Age	Spruce ≤ 140 years G/M	Spruce > 140 years G/M	Spruce ≤ 140 years P/L	Spruce > 140 years P/L	Pine ≤ 140 years G/M	Pine > 140 years G/M	Pine ≤ 140 years P/L	Pine > 140 years P/L
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	0.00	0.00	0.00	0.00	0.19	0.22	0.02	0.05
30	0.14	0.06	0.02	0.00	15.70	6.61	0.15	0.40
40	12.88	7.32	0.07	0.02	61.69	45.87	6.21	5.53
50	51.66	39.35	2.23	1.33	106.88	89.14	36.13	33.59
60	103.63	92.27	17.89	10.18	146.94	127.44	67.07	64.52
70	151.26	140.02	50.74	32.02	182.46	161.40	95.78	92.92
80	193.55	182.18	86.14	61.66	213.99	191.61	122.09	118.78
90	230.22	218.03	119.08	92.63	242.76	219.20	146.87	142.90
100	262.18	248.83	149.27	121.17	268.96	244.35	170.00	165.29
110	290.14	275.33	176.83	147.08	292.98	267.41	191.64	186.13
120	314.14	297.96	201.81	170.50	315.15	288.70	211.99	205.63
130	336.72	319.79	225.42	193.00	335.96	308.86	231.27	224.16
140	355.78	339.02	246.23	213.51	350.01	322.79	244.77	237.44
150	372.22	355.93	264.78	232.18	361.03	333.86	255.54	248.17
160	386.07	370.77	280.88	249.14	368.93	342.07	263.56	256.37
170	397.93	383.82	295.07	264.55	373.88	347.51	268.89	262.09
180	408.19	395.48	307.59	278.60	374.99	350.19	271.54	265.35
190	416.91	405.84	318.57	291.38	375.89	350.14	271.54	266.17
200	425.38	415.39	329.08	303.33	377.56	353.13	274.34	269.43
210	433.14	424.09	338.80	314.38	380.38	356.30	277.30	272.76
220	440.25	432.03	347.76	324.62	383.26	359.45	280.23	276.01
230	446.74	439.28	356.03	334.11	386.10	362.52	283.04	279.12
240	452.69	445.92	363.65	342.92	388.83	365.44	285.70	282.04
250	458.14	452.02	370.71	351.12	391.42	368.20	288.19	284.78
260	461.29	455.50	375.50	356.30	393.37	370.26	290.18	286.89
270	464.12	458.61	379.88	361.06	395.18	372.17	292.01	288.82
280	466.67	461.36	383.86	365.43	396.85	373.92	293.65	290.57
290	468.93	463.81	387.49	369.44	398.38	375.53	295.13	292.15
300	470.93	465.97	390.77	373.12	399.76	376.97	296.42	293.55
310	472.72	467.86	393.77	376.50	401.01	378.27	297.55	294.80
320	474.30	469.53	396.47	379.58	402.11	379.42	298.51	295.87
330	475.69	471.00	398.90	382.38	403.08	380.41	299.32	296.79
340	476.92	472.26	401.10	384.91	403.92	381.28	299.96	297.56
350	477.98	473.36	403.04	387.19	404.62	382.01	300.46	298.18

(continued)

A.5 Volume Estimates for Existing Stands

Table A-22. Timber volume tables for existing natural stands (cubic metres)

Table	23	24	25	26	28	29	30
Age	Fir Dry Selection PA 16	Fir Dry Small Patch PA 16	Fir Wet PA 16	Cedar PA 16	Balsam PA 16	Spruce PA 16	Pine PA 16
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	0.00	0.00	0.00	0.04	0.00	0.00	0.01
30	0.00	0.00	0.03	0.18	3.07	0.06	0.08
40	0.08	0.69	1.61	10.31	14.07	0.83	4.33
50	2.11	6.02	16.19	35.09	32.22	6.53	26.84
60	7.08	18.24	38.97	61.61	55.23	30.96	54.34
70	13.00	33.58	61.21	85.81	81.81	63.15	80.53
80	18.90	48.54	81.19	108.17	102.93	95.19	104.84
90	24.43	62.53	99.29	127.46	121.38	125.99	127.82
100	29.56	75.46	115.68	144.68	138.16	154.52	149.35
110	34.28	87.35	130.56	160.20	153.54	180.74	169.58
120	38.64	98.27	144.06	174.02	167.63	204.67	188.64
130	42.75	108.31	156.48	188.22	182.87	227.07	206.75
140	46.50	117.47	167.52	200.66	197.29	246.78	219.51
150	49.98	125.96	177.56	212.57	210.94	264.49	229.72
160	53.17	133.65	186.38	223.66	223.72	279.49	237.36
170	56.13	140.85	194.37	234.31	235.81	292.85	242.49
180	58.87	147.50	201.64	244.60	247.23	304.68	245.13
190	61.40	153.73	208.18	254.54	258.04	315.11	245.28
200	63.86	159.72	214.63	264.13	268.61	325.09	248.00
210	66.18	165.37	220.74	273.37	278.82	334.31	250.84
220	68.40	170.79	226.52	283.87	288.67	342.80	253.64
230	70.51	175.93	232.01	294.53	298.18	350.65	256.33
240	72.52	180.82	237.22	304.88	307.35	357.88	258.86
250	74.44	185.53	242.18	315.09	316.20	364.58	261.22
260	74.51	185.68	242.76	315.27	318.03	369.41	263.13
270	74.58	185.81	243.27	315.43	319.76	373.85	264.87
280	74.64	185.95	243.74	315.60	321.40	377.93	266.44
290	74.69	186.07	244.16	315.77	322.94	381.68	267.83
300	74.73	186.19	244.54	315.90	324.40	385.12	269.05
310	74.77	186.29	244.87	316.02	325.77	388.29	270.12
320	74.81	186.38	245.18	316.16	327.07	391.20	271.02
330	74.84	186.47	245.45	316.29	328.28	393.86	271.76
340	74.86	186.55	245.68	316.38	329.44	396.31	272.36
350	74.89	186.63	245.88	316.50	330.53	398.58	272.80

(continued)

A.5 Volume Estimates for Existing Stands

Table A-22. Timber volume tables for existing natural stands (cubic metres) (concluded)

Table	31	32	33	34	35
Age	Deciduous PA 16	Cedar G/M,8+ C/H partition	Cedar P/L,8+ C/H partition	Hemlock G/M,8+ C/H partition	Hemlock P/L,8+ C/H partition
10	0.00	0.00	0.00	0.00	0.00
20	0.00	0.00	0.00	0.00	0.00
30	2.12	2.74	0.2	1.11	0.00
40	19.51	57.93	16.05	30.07	1.13
50	47.29	112.66	56.1	96.02	18.58
60	75.83	163.09	95.07	154.93	58.54
70	102.74	208.18	129.94	206.93	103.76
80	124.99	249.59	161.85	252.53	146.22
90	144.72	277.12	184.33	285.27	179.99
100	161.54	297.78	201.76	310.59	207.65
110	175.43	313.15	215.26	330.03	230.29
120	186.50	323.21	224.86	344.16	248.15
130	194.42	346.31	243.02	366.09	271.28
140	201.59	369.33	260.88	385.58	292.08
150	207.88	390.96	277.64	403.03	310.90
160	210.78	411.18	293.27	418.43	327.79
170	213.20	430.07	307.83	431.81	342.73
180	215.17	448.22	321.84	443.78	356.24
190	216.71	465.42	335.07	454.19	368.13
200	218.50	482.29	348.12	465.01	380.40
210	220.21	498.55	360.73	475.26	392.16
220	221.86	517.41	375.22	484.44	403.41
230	223.42	535.81	389.65	492.68	414.16
240	224.91	553.66	403.83	500.43	424.29
250	226.32	570.85	417.76	507.70	433.79
260	226.76	572.27	419.72	510.53	438.66
270	227.16	573.61	421.51	513.12	443.00
280	227.52	574.83	423.12	515.53	446.88
290	227.86	575.98	424.57	517.75	450.40
300	228.16	577.05	425.92	519.82	453.63
310	228.43	578.04	427.16	521.75	456.60
320	228.67	578.97	428.30	523.52	459.37
330	228.88	579.82	429.38	525.18	461.98
340	229.06	580.62	430.39	526.73	464.42
350	229.23	581.33	431.34	528.22	466.75

A.6 Volume Estimates for Regenerated Stands

WinTIPSY (Windows™ version of the Table Interpolation Program for Stand Yields) version 1.4, supported by the B.C. Ministry of Forests, Research Branch, was used to estimate growth and yield for existing and future managed stands. The area-weighted site index and regeneration assumptions for each analysis unit were used as inputs to TIPSY. Section A.4.6, "Immature plantation history" and Table A-17. document which stands are assumed to be managed in the analysis.

Operational adjustment factors (OAFs) used in managed stand yield table generation were:

> OAF1 of 15% (a constant percentage reduction at all ages to represent incomplete site occupancy, for example, small holes in a stand), and
>
> OAF2 of 5% (an increasing reduction, to represent losses such as decay that increase with stand age).

Table A-23. displays the volume tables for managed stands. Volumes are assumed to remain constant after 300 years of age. For some tables there was insufficient growth and yield information to model to 300 years of age — data to maximum ages are presented and the maximum volume is carried forward to 300 years of age.

For selection analysis units (51 and 73), the volumes shown represent 30% of the original standing volume, which is harvestable on a 30-year cycle. First-pass harvest volumes for selection stands are shown in Table A-22.

A.6 Volume Estimates for Regenerated Stands

Table A-23. Timber volume tables for managed stands (cubic metres)

Table	51	52	53	54	55	56	57
Age	Fir Dry Selection	Fir Dry Small Patch	Fir Wet ≤ 140 years G/M	Fir Wet > 140 years G/M	Fir Wet ≤ 140 years P/L	Fir Wet > 140 years P/L	Cedar ≤ 140 years G/M
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30	0.00	1.00	5.00	1.00	0.00	0.00	3.00
40	1.00	8.00	36.00	15.00	3.00	4.00	42.00
50	4.00	31.00	92.00	49.00	18.00	20.00	123.00
60	9.00	63.00	160.00	97.00	48.00	52.00	209.00
70	15.00	99.00	217.00	152.00	77.00	81.00	284.00
80	21.00	139.00	268.00	197.00	106.00	111.00	350.00
90	26.00	174.00	313.00	237.00	134.00	141.00	406.00
100	32.00	202.00	350.00	273.00	165.00	172.00	450.00
110	37.00	227.00	384.00	305.00	192.00	199.00	489.00
120	42.00	252.00	414.00	331.00	214.00	220.00	521.00
130	46.00	274.00	439.00	354.00	232.00	239.00	547.00
140	50.00	293.00	459.00	375.00	249.00	256.00	571.00
150	53.00	310.00	475.00	394.00	263.00	270.00	589.00
160	57.00	326.00	491.00	411.00	276.00	283.00	606.00
170	59.00	341.00		426.00	287.00	294.00	
180	62.00	354.00		438.00	298.00	304.00	
190	65.00	366.00		447.00	307.00	313.00	
200	67.00	377.0		455.00	314.00	319.00	
210	70.00	386.00		463.00	319.00	325.00	
220	72.00	395.00		470.00	325.00	331.00	
230	74.00	403.00		477.00	329.00	336.00	
240	76.00	409.00		483.00	334.00	340.00	
250	78.00	415.00		488.00	338.00	344.00	

(continued)

A.6 Volume Estimates for Regenerated Stands

Table A-23. Timber volume tables for managed stands (cubic metres)

Table	58	59	60	61	62	63	64
Age	Cedar ≤ 140 years P/L	Hemlock ≤ 140 years G/M	Hemlock ≤ 140 years P/L	Balsam ≤ 140 years G/M	Balsam > 140 years G/M,8+	Balsam ≤ 140 years P/L	Balsam > 140 years P/L, 8+
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30	0.00	2.00	0.00	0.00	0.00	0.00	0.00
40	2.00	34.00	3.00	1.00	0.00	0.00	0.00
50	13.00	109.00	20.00	26.00	10.00	2.00	1.00
60	53.00	190.00	65.00	85.00	49.00	9.00	5.00
70	100.00	261.00	115.00	155.00	106.00	34.00	24.00
80	146.00	327.00	165.00	214.00	167.00	71.00	57.00
90	191.00	383.00	209.00	270.00	218.00	112.00	95.00
100	232.00	428.00	252.00	328.00	267.00	155.00	136.00
110	267.00	465.00	291.00	370.00	317.00	190.00	173.00
120	297.00	497.00	322.00	400.00	356.00	225.00	206.00
130	322.00	524.00	348.00	424.00	386.00	259.00	237.00
140	345.00	547.00	370.00	443.00	409.00	292.00	270.00
150	366.00	567.00	389.00	458.00	426.00	319.00	301.00
160	384.00	581.00	406.00	470.00	441.00	342.00	324.00
170	399.00	593.00	421.00	481.00	453.00	360.00	345.00
180	413.00	604.00	433.00	488.00	463.00	375.00	360.00
190	426.00		444.00	495.00	472.00	387.00	374.00
200	437.00		454.00	501.00	478.00	397.00	386.00
210	447.00		462.00	501.00	483.00	406.00	395.00
220	457.00		470.00	499.00	488.00	414.00	403.00
230	466.00		478.00	497.00	492.00	421.00	410.00
240	472.00		483.00	496.00	492.00	426.00	416.00
250	477.00		486.00	494.00	490.00	432.00	422.00

(continued)

A.6 Volume Estimates for Regenerated Stands

Table A-23. Timber volume tables for managed stands (cubic metres)

Table	65	66	67	68	69	70	71
Age	Spruce ≤ 140 years G/M	Spruce > 140 years G/M	Spruce ≤ 140 years P/L	Spruce > 140 years P/L	Pine ≤ 140 years G/M	Pine > 140 years G/M	Pine ≤ 140 years P/L
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30	1.00	1.00	0.00	0.00	23.00	14.00	1.00
40	15.00	16.00	0.00	0.00	75.00	53.00	13.00
50	63.00	65.00	3.00	1.00	131.00	108.00	39.00
60	130.00	132.00	16.00	6.00	179.00	152.00	69.00
70	198.00	199.00	48.00	29.00	231.00	193.00	104.00
80	255.00	257.00	91.00	65.00	270.00	236.00	130.00
90	312.00	314.00	138.00	106.00	303.00	268.00	154.00
100	356.00	358.00	181.00	151.00	331.00	295.00	176.00
110	388.00	389.00	219.00	187.00	352.00	318.00	197.00
120	412.00	413.00	256.00	222.00	369.00	337.00	219.00
130	431.00	432.00	294.00	256.00	384.00	352.00	239.00
140	445.00	447.00	325.00	290.00	396.00	364.00	254.00
150	458.00	459.00	351.00	319.00	406.00	375.00	266.00
160	467.00	468.00	371.00	343.00	415.00	384.00	277.00
170	475.00	476.00	387.00	362.00	423.00	392.00	287.00
180	482.00	483.00	401.00	378.00	429.00	398.00	295.00
190	482.00	483.00	412.00	391.00	432.00	404.00	301.00
200	482.00	482.00	422.00	401.00	435.00	409.00	307.00
210	481.00	482.00	430.00	411.00	438.00	413.00	312.00
220	481.00	481.00	437.00	419.00	441.00	416.00	317.00
230	480.00	481.00	443.00	426.00	443.00	418.00	321.00
240	479.00	480.00	449.00	432.00	445.00	418.00	325.00
250	478.00	479.00	452.00	437.00	447.00	419.00	328.00

(continued)

A.6 Volume Estimates for Regenerated Stands

Table A-23. Timber volume tables for managed stands (cubic metres)

Table	72	73	74	75	76	78
Age	Pine > 140 years P/L	Fir Dry Selection PA 16	Fir Dry Small Patch PA 16	Fir Wet PA 16	Cedar PA 16	Balsam PA16
10	0.00	0.00	0.00	0.00	0.00	0.00
20	0.00	0.00	0.00	0.00	0.00	0.00
30	1.00	0.00	0.00	0.00	0.00	0.00
40	15.00	0.00	0.00	2.00	0.00	0.00
50	41.00	2.00	2.00	12.00	1.00	2.00
60	73.00	5.00	9.00	34.00	8.00	11.00
70	108.00	10.00	21.00	60.00	30.00	37.00
80	134.00	14.00	36.00	86.00	61.00	75.00
90	158.00	18.00	55.00	112.00	93.00	117.00
100	180.00	22.00	73.00	136.00	125.00	159.00
110	203.00	26.00	90.00	163.00	153.00	195.00
120	225.00	29.00	107.00	186.00	181.00	230.00
130	244.00	32.00	124.00	06.00	208.00	264.00
140	259.00	35.00	140.00	222.00	233.00	298.00
150	272.00	37.00	154.00	237.00	253.00	324.00
160	283.00	40.00	166.00	249.00	271.00	347.00
170	292.00	42.00	176.00	261.00	285.00	364.00
180	299.00	44.00	185.00	270.00	298.00	379.00
190	306.00	46.00	193.00	279.00	309.0	391.00
200	312.00	48.00	201.00	287.00	319.00	400.00
210	317.00	50.00	208.00	294.00	327.00	409.00
220	322.00	51.00	214.00	301.00	335.00	417.00
230	326.00	53.00	219.00	306.00	343.00	423.00
240	330.00	54.00	225.00	310.00	350.00	429.00
250	331.00	56.00	230.00	313.00	357.00	435.00

(continued)

A.6 Volume Estimates for Regenerated Stands

Table A-23. Timber volume tables for managed stands (cubic metres) (concluded)

Table	79	80	82	83	84	85
Age	Spruce PA 16	Pine PA 16	Cedar > 140 years G/M C/H Partition	Cedar > 140 years P/L C/H Partition	Hemlock > 140 years G/M C/H Partition	Hemlock > 140 years P/L C/H Partition
10	0.00	0.00	0.00	0.00	0.00	0.00
20	0.00	0.00	0.00	0.00	0.00	0.00
30	0.00	0.00	1.00	0.00	1.00	0.00
40	0.00	10.00	22.00	2.00	13.00	1.00
50	3.00	35.00	88.00	14.00	68.00	8.00
60	15.00	62.00	166.00	54.00	149.00	36.00
70	47.00	97.00	237.00	102.00	204.00	78.00
80	89.00	123.00	301.00	148.00	264.00	123.00
90	136.00	146.00	355.00	193.00	319.00	164.00
100	179.00	168.00	401.00	234.00	365.00	201.00
110	217.00	187.00	438.00	270.0	403.00	237.00
120	253.00	208.00	470.00	299.00	435.00	272.00
130	291.00	227.00	498.00	324.00	462.00	301.00
140	323.00	245.00	520.00	348.00	485.00	324.00
150	349.00	257.00	540.00	368.00	506.00	343.00
160	369.00	268.00	556.00	386.00	523.00	360.00
170	386.00	278.00	569.00	402.00	538.00	374.00
180	399.00	286.00	581.00	416.00	549.00	387.00
190	410.00	293.00	592.00	429.00	558.00	398.00
200	420.00	299.00	601.00	440.00	565.00	408.00
210	429.00	304.00	609.00	450.00	572.00	417.00
220	436.00	309.00		460.00	579.00	426.00
230	442.00	313.00		469.00	585.00	433.00
240	448.00	317.00		474.00	590.00	439.00
250	451.00	320.00		480.00	595.00	445.00

Appendix B

Socio-Economic Analysis Background Information

B.1 Limitations of Economic Analysis

The socio-economic analysis portion of this report identifies employment and income impacts, changes in government revenues, and community impacts as a result of changes in the TSA's harvest levels over time. Some of the assumptions used in this report are as follows:

- **Employment multiplier** — employment multipliers are used to estimate indirect and induced employment impacts of a change in direct industry activity. The calculation of employment multipliers is based on analytical assumptions and data collected at a specific time period. The multipliers reflect industry and employment conditions at that time and may not accurately reflect industry and employment conditions in the future.
- **Employment coefficient** — employment coefficients are ratios of person-years of employment per 1000 cubic metres of timber harvested. These ratios are used to estimate employment levels associated with alternative harvest rates. This method of analysis assumes that the industry structure will be the same in the future as it is today. While reasonably accurate in the short term, employment coefficients may change in the future due to changes in market conditions, product mix or production technologies.
- **Timing of impacts** — employment impacts are shown to occur simultaneously with a change in the harvest level. While this assumption is reasonably accurate for the harvesting sub-sector, employment estimates for the silviculture and timber processing sub-sectors may not be as coincidental. As well, indirect and induced impacts tend to occur over a longer period, as levels of business and consumer spending adjust to changes in harvest levels.
- **Operating thresholds of mills** — it is unlikely that impacts on timber processing employment due to changes in harvest levels will be in direct proportion to the harvest changes (i.e., a 10% change in harvest may not lead to a 10% change in timber processing employment). Impacts on timber processing employment are more likely to occur step-wise related to operating thresholds of mills. For example, if a mill's timber supply is reduced, its operating threshold is reached when the decrease in timber supply causes it to lay off a shift of workers or to close the mill, either temporarily or permanently. Conversely, if the timber supply to the mill is increased, a processing threshold is reached when the mill has to decide whether to add another shift of workers or new capacity to process the increase in timber supply. In both cases, the per cent change in employment in the mill would probably differ from the per cent change in the timber processed. Because mills have many different operating configurations, accurately predicting an individual mill's operating threshold is impossible. As a result, impact figures pertaining to employment in timber processing are best interpreted as size of change rather than as precise changes in employment levels.
- **Government expenditures** — provincial government expenditures are more related to government policy and population levels than to industry activity. As such, expenditures on education, health care and other government services are assumed to remain unchanged despite changes to the harvest level and subsequent changes in government revenues from the forestry sector. However, provincial government expenditures would likely change if a community's population significantly changes. This would amplify the community impacts of losses or gains in forestry sector jobs.
- **Proportional harvest reductions** — harvest reductions are assumed to be proportionately distributed among all licensees and all forms of tenure within the TSA.

B.2 Economic Impact Analysis Methodology

Data sources

Data for the socio-economic analysis were obtained from several sources. Harvest volume and stumpage data are from the Ministry of Forests. Timber flow and employment data are from responses to questionnaires that were sent to licensees, operators and processing facilities in the TSA. Other general economic data are from BC STATS, Statistics Canada and local communities. Estimates of taxes paid by the forest industry are from PriceWaterhouseCoopers.

Person-year of employment

The unit of measurement for employment is a person-year. A person-year of employment is defined as a full-time job, which lasts at least 180 days per year. Part-time jobs were converted to equivalent full-time person-years of employment.

To estimate employment and income impacts associated with changes in TSA timber harvest levels, the forestry sector was divided into three sub-sectors:

1. harvesting;
2. silviculture; and
3. timber processing.

Employment and income impacts were estimated in several steps. The first step was to assess current activity in each of the three sub-sectors. Then, indirect and induced employment and employment income impacts were estimated, using data from BC STATS (1996) and Statistics Canada. Next, employment coefficients were calculated and then applied to the base case harvest forecast. Other indicators of the forestry sector's contribution to the provincial economy, such as government revenues and industry taxes were also calculated, using Ministry of Forests stumpage estimates and other data sources.

Employment — harvesting

Direct employment in harvesting consists of all woodlands-related jobs including harvesting, log salvage, planning and administration functions and log transportation. The employment multipliers used in this analysis define activities such as road building or maintenance work as indirect employment rather than direct employment because the forestry sector and other basic sectors purchase these services.

Data on employment, place of residence and timber flows were obtained from responses to questionnaires that were sent to licensees and operators in the TSA. The information was then used to estimate employment averages associated with harvest changes and the proportion of residents *versus* non-residents who work in the TSA.

Two estimates of direct employment in harvesting were calculated:

1. TSA direct employment in harvesting consists of employees who are engaged in harvesting and related activities within the TSA and who reside in communities within the TSA; and
2. Provincial direct employment in harvesting consists of employees who are engaged in harvesting, as above, plus those workers who reside outside the TSA, but who come to the TSA to work in harvesting and harvesting-related activities.

The estimates of TSA and provincial direct employment in harvesting were used to calculate employment coefficients per 1000 cubic metres. These employment coefficients were then used to estimate harvesting employment associated with the different harvest levels in the base case forecast.

B.2 Economic Impact Analysis Methodology

Employment — silviculture

Silviculture employment consists of all basic and intensive reforestation activities, including surveys, site preparation, planting, fertilization, pruning and spacing. Silviculture employment data were collected from the Ministry of Forests and licensees whose tenures require post-harvest silviculture work. Most silviculture work is seasonal and silviculture employees usually only work part time during the year. Because of this, information on silviculture employment was converted into equivalent full-time person-years of employment. Respondents were also asked to estimate the percentage of their silviculture employees who resided within the TSA and outside the TSA.

As with the harvesting sub-sector, two estimates of direct employment in silviculture were calculated: one for the TSA and another for the province. These employment figures were used to calculate employment coefficients for silviculture employment in the same manner as the employment coefficients for harvest employment.

Employment — timber processing

Information about employment, production and sources of timber was gathered from mills. Information was also gathered as to whether timber harvested from the TSA was processed within the TSA or outside the TSA. This information indicates the degree of dependence the mills have on timber harvested within the TSA. To estimate the share of processing employment supported by TSA timber, mill employment was prorated by the relative contribution of timber from the TSA to a mill's total timber requirement. For example, if 80% of a plant's timber supply is from the harvest of the TSA, then 80% of the employment in the plant would be attributable to the TSA harvest. Employment figures were also adjusted to reflect the residences of workers (i.e., those who lived within the TSA and those who lived outside the TSA). Employment in timber processing that is supported by chip by-products from milling operations was also similarly estimated.

As with the harvesting sub-sector, two estimates of direct employment in timber processing were calculated: one for the TSA and another for the province. These employment figures were used to calculate employment coefficients for timber processing employment in the same manner as the employment coefficients for harvest employment.

Indirect and induced employment estimates

Indirect employment in the forestry sector refers to those who provide goods and services to firms directly engaged in the basic forestry sector (for example, those who build or maintain road for log transport). Induced employment refers to those who provide the goods and services purchased by employees who are directly and indirectly engaged in the industry (for example, those who work in retail outlets). Indirect and induced employment figures were calculated using TSA and provincial employment multipliers developed by BC STATS.

Two sets of employment multipliers were calculated for this report: a migration multiplier and a no-migration multiplier. The migration multipliers assume that displaced workers will leave the region, reducing total income in the region by their full wage. The no-migration multipliers assume that displaced workers remain in the area, at least in the short term, and unemployment and other social safety net payments temporarily offset some of the income loss. Using the no-migration multipliers diminishes the degree of induced impacts associated with a change in direct employment.

B.2 Economic Impact Analysis Methodology

The TSA and provincial employment multipliers used in the Kamloops TSA analysis are shown in Table B-1.

Table B-1. Employment multipliers — Kamloops TSA

Forestry sub-sector	Kamloops TSA migration multiplier	Kamloops TSA no-migration multiplier	Provincial (interior) migration multiplier	Provincial (interior) no-migration multiplier
Harvesting	1.62	1.39	2.14	1.80
Solid wood processing	1.61	1.35	2.29	1.93
Pulp and paper	2.14	1.79	3.02	2.48

Sources: B.C. Ministry of Finance and Corporate Relations. 1999. The 1996 Forest District Tables.

B.C. Ministry of Finance and Corporate Relations. 1996. A provincial impact estimation procedure for the British Columbia forestry sector.

Estimates of employment income

Employment income was calculated using average income estimates for workers in the forest industry. Based on Statistics Canada data, the weighted average annual pre-tax income (less benefits) for forestry sector workers during the period 1998 to 2000 (in 1999 dollars) was:

$47,100 for those working in logging and forestry services;

$44,900 for those working in solid wood manufacturing; and

$56,400 for those working in pulp and paper mills.

Those in indirect and induced occupations earned approximately $30,800. Income taxes were calculated based on marginal tax rates of 23–28% with one-third of the total income tax paid accruing to the province.

Employment estimates of alternate timber supply levels

To estimate employment generated by alternative timber supplies, the forecast harvest level is multiplied by the calculated employment coefficients. Note that employment coefficients are based on current industry productivity, harvest practices and forest management assumptions and will not likely reflect industry operating conditions in future years. Therefore, the employment estimates should be viewed as indicators of size of change rather than as precise estimates of changes in employment levels.

B.2 Economic Impact Analysis Methodology

Provincial government revenues

Except for stumpage, royalty and rents, which are specific to the TSA, provincial government revenue impacts were estimated by using industry averages. Revenues per 1000 cubic metres of harvest, expressed as dollars per 1000 cubic metres, were calculated and applied to the harvest levels in the base case forecast in a manner similar to how employment impacts were estimated (Table B-2).

Table B-2. Estimates of provincial government revenues — Kamloops TSA

	Average annual revenue 1997–2000 ($ 1999 millions)	Revenue ($ per '000s m^3)
Stumpage and related payments[a]	59.7	22 375
Forest industry taxes[b]	19.8	7 425
Employee income tax[c]	17.1	6 400
Total	96.6	36 200

(a) Source: Ministry of Forests, Revenue Branch.

(b) Based on estimates by PriceWaterhouseCoopers. Includes taxes for logging, corporate income, corporate capital, sales, property and electricity.

(c) Estimated from Revenue Canada income tax rates and includes only the provincial share of income taxes paid.